THE MONTHLY

JOURNAL OF SCIENCE,

AND ANNALS OF

BIOLOGY, ASTRONOMY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

Vol. I. (THIRD SERIES)
No. LXV.

MAY
1879.

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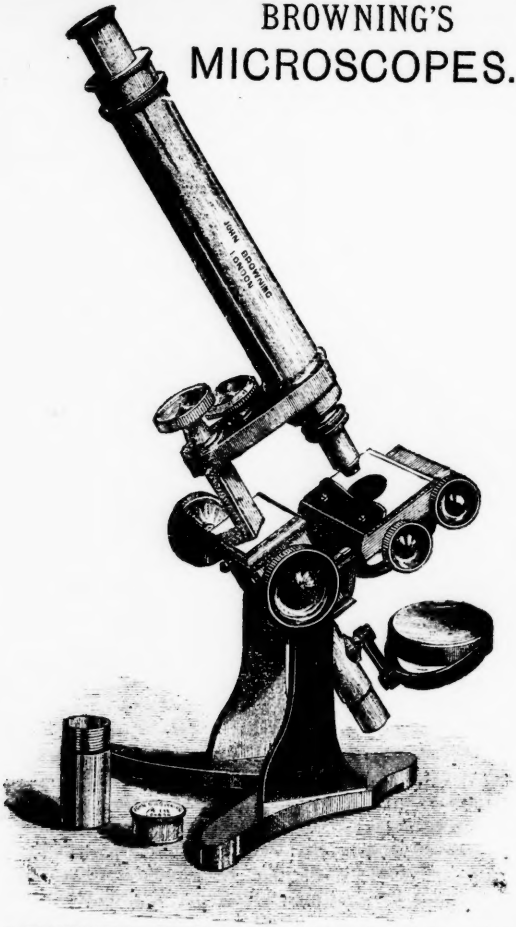

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XUM

THE MONTHLY

JOURNAL OF SCIENCE.

MAY, 1879.

I. THE SPIRITUAL IN ANIMALS.

CERTAIN writers, who have given up as untenable every other alleged ground of distinction between man and his "poor relations," take their final stand on the religious sentiment—on the recognition of a God and the belief in a future state: this, in their opinion, forms the final and insurmountable barrier. Before we can be expected to admit this assumed distinction it must be shown to our satisfaction, first, that all normal men are spontaneously worshippers; and, secondly, that all other animals are incapable of religious emotions. All other animals, we repeat; for if in any one species there can be found a trace of the "God-idea," then the boundary-line—whatever it may be worth—will run in an unwelcome direction, including that one species together with man, whilst excluding all the rest of the animal creation. Now where is the evidence that "brutes" are destitute of the religious sentiment? Simply nowhere. Who will dare to say that he has analysed all the emotions that pass through the mind of every animal? that he has looked upon the world with its eyes? Who can even guarantee that none of the actions of brutes have a religious significance? If we reflect how strangely varied are the devotional rites even of our own species, should we not pause before authoritatively deciding what must be the worship of other beings? The whole matter rests upon assumption. Man has complacently taken for granted that a "mere brute" must of necessity be without any trace of religion, and then, arguing in a circle, has elevated this imagined incapability of religion into a boundary-line between man and "mere brutes." We cannot recognise the validity of such reasoning. Lord Herbert of Cherbury,

John Wesley, Meinhold, Quatrefages, and their followers, will possibly claim the right to assume the absence of the religious feeling in any animal till its presence shall have been formally demonstrated. We deny their claim. Before any attribute can be selected as distinguishing one body from another, its presence in the former and its absence in the latter must both be equally proved, not merely guessed. That the lower animals build churches and chapels, maintain a clergy, get up revival meetings, or distribute tracts, no one contends. But have they no dim but overshadowing consciousness of an Unseen Power behind, and above the visible and the tangible? Does not anything to them unwonted and unintelligible inspire them at times with awe, as contradistinguished from fear? Have they not—especially such as have been brought into human society—some vague idea of the last great change? Do we not find among them, in short, many indications of that lowest stage of religion—whether incipient or degraded it is not our business to inquire—which it is now the fashion to call fetichism? To us the cases lately observed and recorded by Mr. J. G. Romanes and others seem strongly to favour this view.

But it may again be doubted whether man gives everywhere more decided proofs of religious emotions. Unless this also is shown to be a rule without exception, the proposed boundary-line must again be declared at fault. To take only one instance: the Veddahs of Ceylon, as we are informed on good authority,* "have no knowledge of a God or of a future state; no temples, idols, prayers, or charms; no instincts of worship." Are they, therefore, men or brutes?

A kindred question here presents itself. Personal immortality—a second and prolonged, or rather never-ending, life—is claimed as a characteristic attribute of their own race by all the more cultivated portion of mankind, with the exception of a small minority of so-called materialists,† and is almost with one accord denied to brutes.

Many estimable persons will therefore be shocked at the declaration of the late Prof. Agassiz—himself certainly no materialist—that "most of the arguments for human immortality apply to other animals quite as forcibly." Take,

* TENNENT, Ceylon, vol. ii., p. 442.

† An unhappily-chosen term. A materialist, correctly speaking, is one who in opposition to the idealist ascribes to matter substantive existence independent of the perceiving mind. In common usage it is applied to one who denies the existence of spiritual beings, and who ought rather to be styled an "apneumatist."

for example, the doctrine of compensation, so much insisted on in the case of man. If a "land of the leal" hereafter be needed to atone for the inequalities of the present human life, the same plea may be urged also on behalf of the lower animals. How widely different, for example, may be the respective lots of horses. One may first see the light in a ducal stable, more comfortable than many a human dwelling; he is reared and trained with the utmost care and consideration, and fed on the choicest food suitable to his tastes; he becomes the pet of some lady of rank, and knows no harder task than to carry his mistress along Rotten Row. Another, from no fault of his own, is foaled in some rude shed, grows up amidst hunger, cruelty, and neglect, and before his bones and muscles are matured is doomed to drag a costermonger's cart—a similar fate to that which modern industrialism has prepared for the limbs and competitive examination for the brains of the young of our own species. Are not the respective destinies of these two horses almost as unequal as those of the financier and the farm-labourer?

It may perhaps be contended that such inequalities are due not to Nature, but to man's interference. Let us, therefore, take an animal species not under special or direct human influence. Suppose any common female butterfly—say a *Vanessa Atalanta*—lays one hundred eggs. A portion of these never come to life at all, or are destroyed by a variety of causes before hatching. The remainder become caterpillars in due course, but very few ever reach maturity. Some are devoured by birds; others are pierced by ichneumons, and slowly consumed by parasitical larvæ. A few pass safely through their early stages of being, and come forth as butterflies. But here again one in the very outset of his career may perish in a spider's web; another may encounter its fate in the net of a collector, whilst the birds will not fail to secure an ample share. A very few only of the original hundred will live out their allotted span, find mates, and die finally a natural death. Is not here, also, a fair case made out for a hereafter to balance the capricious inequalities of the present?

In like manner we may deal with the other arguments for human immortality, and show their applicability to the lower animals. Thus orators and essayists love to enlarge on the unsatisfactory nature of human life. It is, they tell us, vain, empty, and incapable of filling our desires—a discovery which by the way is never made until health or strength, or at any rate elasticity and animal spirits, are

declining. This, rightly or wrongly, is taken as a proof that we were intended for a higher destiny than this world can offer. But the lower animals likewise become life-weary; the gaiety and buoyancy of their earlier days vanishes; they, too, feel inclined to exclaim with the poet—

"Life is had,
And then we sigh and say, can this be all?"

The melancholy which all animals experience in the evening of their day is fundamentally the same. From the *vanitas vanitatum* of Solomon to the sadness of "a gib-cat, or a lugged bear, or an old lion," there is one continued series of phenomena, differing in degree, but alike in kind and in cause.

Have the lower animals, then, no right to say that life has palled on their taste—that this world does not satisfy their cravings? It is possible, indeed, that if a draught of some magic elixir could restore to them all they have left behind in the flight of years,—their youthful vigour and their flow of spirits,—this melancholy would disappear. But would not a similar change come over man?

Again we proclaim that our being is in part spiritual, on the very satisfactory ground that mere matter cannot be supposed to think, remember, reason, or even see or hear, and that spirit, being of its own essence indestructible, our immortality necessarily follows.* Be it so: the lower animals also see and hear, think, and remember. On our own showing, then, their nature, like our own, is partly spiritual, and like ourselves—if spirit is essentially indestructible—they may look forward to a future life. What that life may be for them we have not the faintest knowledge. It may have relations with that which awaits ourselves, or it may be totally distinct. We question if the more highly organised among them would find the prospect of annihilation satisfactory. To a transmigration of souls they would also have good right to object. To be perhaps born again as men of the nineteenth century—heirs to "competitive examination, sewage irrigation, and international arbitration," with the woman's rights movement

* A strange writer in a somewhat heterodox journal, whilst assigning souls to animals, plants, and, if we understand him rightly, to minerals, and whilst fully admitting the immortality of the spiritual part of man, does not consider such part as indivisible. On the contrary, he maintains that the soul of every animal is an offset from that of its male parent. Every spermatozooid—or, as he holds, spermatozoon—contains a portion of the soul of the animal by which it is secreted. The female parent contributes merely the material part of the young animal. How all these points were ascertained it does not appear.

looming in the future—they might, perhaps, feel it preferable to sleep on for ever beneath the shade of their good green woods.

Will the future existence, either of man or brute, be more than merely linear, as at present? Who has not felt, at times, a craving for multipresence—a wish to see and enjoy at once what in this life we can only behold successively? As with sight, so also with all the other faculties of our being. Shall we be always restricted to the exercise of one only function at a time? Must the intellectual, the esthetic, the sensuous, and the moral phases of our being always merely relieve each other on duty? Of all the many limitations of our earth-life none is more irksome than this. Many a time when on a journey we have repined that we could not stay at some beautiful spot, and at the same time go on to other scenes not less lovely. The burden of a strange old song rings continually in our ears:—

> "For say, O why must the whitethorn fade
> Before the rose can bloom."

A bye-question here presents itself. The belief in ghosts —very widely spread among the human species—is frequently brought forward as a corroboration of the existence of unseen, probably immaterial, beings, and hence of the being of God, with whom man, in virtue of his spiritual nature, has an affinity. But in numerous accounts of the alleged appearances of ghosts, and indeed of phenomena not readily to be explained by known physical laws, we find it stated that dogs and other animals were seized with the utmost terror.* Hence it is but fair to argue that if these narratives contain an element of truth, then dogs, as well as men, have an affinity with the spiritual world, and are able to recognise the supernatural. If these stories are mere inventions, exaggerations, or distortions, or if the phenomena though faithfully reported admit of "natural" explanation, then they prove nothing as regards man.

* Ennemoser, History of Magic (Howitt's version), pp. 355, 362, and 395.

II. ANCIENT GLACIER ACTION IN THE PUNJAB:

WITH SPECIAL REFERENCE TO MR. MATTIEU WILLIAMS'S THEORY.

By Major H. A. Tracey, Royal Artillery,
Fort Charles, Kinsale, Co. Cork.

To enable my readers to trace on the map the country alluded to in the following lines, I would remind those who have not hitherto had their attention called to it that from Calcutta, on India's eastern border, to Peshawur, on its N. W. frontier, runs a road whose solid construction, bridges, and embankments rival Rome's magnificent works of the same kind. This Imperial monument of civilisation is about 1700 miles in length, and I, who have travelled more than 1000 miles along it, bear witness that it is but one of many of the grand Imperial highways of India. About 170 miles from the Peshawur end of this road lies the city of Rawul Pindi, and there branches off a road due north towards Cashmir, which in about 50 miles reaches the Cashmir frontier, just beyond the town of Murree.

I was quartered to the N.W. of Murree on a ridge whose geographical position is remarkable, and so narrow that at the part occupied by my hut I could throw out a tumblerful of water that would drain into the Indus from my N.W. windows, while from my opposite window the ground fell away and drained into the Jhelum. I was, in fact, on part of the actual water-shed that the Murree hills form between these rivers. It was on shaly rock we were situated, with occasional bold limestone bluffs. Our height above the sea was 8400 feet. In the autumn of 1876 I had marched from my eyrie beyond Murree to Rawul Pindi, and in the spring of 1877 was in camp at a spot 12 miles due south of it. I was then about 60 miles due south of Murree, but no longer in the "hills," being only about 1200 feet above the sea. While in camp there I received the number for April, 1877, of the "Quarterly Journal of Science," and read the article by Mr. Mattieu Williams, on the "Great Ice Age and Origin of the Till." I only wished I could have offered the author an Arab hospitality, and seated him at my tent-door, when I would have recounted to him some particulars of

my route from Kyra Gully to the spot I was on that I think would have interested him. For instance, first day's march of only 8 miles:—Leave Kyra Gully 8400 feet; descend 1500 feet; ascend to Murree camping-ground, 7600 feet. Shale nearly the whole way, but limestone cropping out here and there. At Murree we got on to sandstone. Next day to Trete, 4000 feet, where the road and ground in section N. and S., goes thus:—

making a little basin: on the outer edges are built a few huts and houses: the whole basin very fertile. We were caught there by heavy rain. I, my men, my horses and mules, spent a miserable night there; every step in the soft red unctuous mud sunk deep; my tents bore its stains after repeated scrubbings, and the rough canvass cover of a valued folding-chair to this day bears witness to the tenacity of the clay with which that rock basin at Trete is filled, and which is unmistakably different to, and more tenacious than, any of the many fine specimens of mud and dirt passed on our way down.

Third day's march to Barakow, 1200 feet, and the plains of the Punjab are entered. The rapid change most oppressive for men and animals. The ground is strewn with great sandstone boulders. The stream that from Kyra Gully has run far below us on our right we cross, and find it swelling into a river, and at Barakow there are deep pools large enough to bathe with comfort in. Good shooting round Barakow, but country all sandstone boulders and scrub.

Fourth day, 17 miles to Rawul Pindi, 1700 feet. A long, level, monotonous tramp, stiflingly hot to us just fresh from higher levels, but delightfully cool to those who rode out to meet us and had spent their summer on the plains. Halfway we halted, where a bend of the river neared the road and a low ridge of sandstone rock ran from east to west, and on the northern side had been scooped out into a deep rock-pool, where lie plenty of fish, which, with the northerly aspect of the sloping rock, make this a favourite picnic spot from Pindi. The range of low sandstone hills run from E. to W., across the rapidly widening mouth of the valley we

have descended, and repeat and lose themselves in the plain, 7 or 8 miles more of which bring us to Rawul Pindi, situated, you will remark, on ground that, rising imperceptibly, is still 500 feet *above* Barakow, and on whose northern side are extensive and dangerous bogs.

Fifth day's march. Pindi to Dargool. Still going due south and ground steadily rising; all hard baked clay, but within a mile of Pindi the ground dips again over another series of low undulating hill, this time not bare rock, but covered with rounded stones of every size from that of an ostrich's egg to a nutmeg. The occasional cuttings for the road show that many feet from the surface these ground and *striated* egg-shaped stones, cemented firmly by tough clay form the face of the country we are travelling over—officers dismount and walk by common consent, drivers take their beasts short by the head, and every one abuses India, the Punjab, and that particular bit between Pindi and Dargool heartily. But after a few miles the stones get smaller and smaller, the great cracks in the dry clay get deeper, the clay banks get higher and look more and more like fortifications, and then we almost suddenly descend into the valley of the stream that has followed us so long and see a level fertile plain in front of us, and the stream now swollen into a river, able to make itself respected, sweeps round under great jagged perpendicular clay walls, between 200 and 300 feet high on its left bank, and of unmistakably the same mixture as stained our tents so badly at Trete; while the right bank is for miles, level smiling young corn fields, among which stand our tents in bright relief near the river's edge.

Reading in that camp Mr. M. Williams's article, and recalling the character of the ground passed over in my recent marches down from the hills immediately north of me, I confess myself a complete convert of his views, and here record facts that seem to me to confirm them.

III. A PLAN FOR ESTABLISHING LIFE-SAVING AND SIGNAL STATIONS IN MID-OCEAN.

By Isaac P. Noyes, Washington, D.C.

As navigation increases between the Old and New World, the necessity for life-saving stations in mid-ocean is more and more felt every year.

This has undoubtedly been a subject that in some way or other has presented itself to many minds; to some as only a passing thought, as quickly away as it came; to others a thought chiefly in connection with its seeming impracticability; while to a few it has been much dwelt upon, in hopes of solving it in some way or other that would be of practical value to mankind, either for the saving of life or for the interest of science. Had this problem, in all its various details, been easy to solve, so as to have become a practical reality, something ere this would have been done toward accomplishing it.

Of course the great impediment in the way is the enormous depth of water, making it, under any present known system, simply absurd to entertain thoughts of locating anything in the shape of a vessel or buoy that must necessarily require such an extensive cable to secure it in its place. There would be no trouble about the anchorage, or the vessel or buoy, in what was at the bottom or at the top, but simply in the connecting link between the two. "Simply" in this case though, like in many others, is the chief and almost impossible thing—that is, seemingly impossible up to this date. As we read the history of the world we see that safety-guards and institutions for the history of science are more and more established as the world progresses, and what at one age would not have been demanded, or even hardly thought of, in another is looked upon as an indispensable necessity. What is considered as impracticable in one age, in another or future age is smiled at and done apparently without the least possible effort, as though it was the most easy and natural thing imaginable.

Such a subject may prompt the question, Is it desirable even if practical? and perhaps many may scout the practicability of such an idea. When we read of some fearful accident or wreck at sea, where some noble ship containing

hundreds of precious lives has gone down with all on board, or only a few left to tell the mournful tale, this question of life-saving stations far out away from land has presented itself in a very forcible manner, and the mind seems impatient and would leap at once to the rescue to prevent or lessen the fearfulness of such catastrophes. But no sooner is this thought through the brain than "How?" presents itself. How overcome this huge difficulty in the way? how make this *connecting link*, the cable, that shall secure the vessel or buoy to the anchorage at the bottom? After a number of years' thought on this subject a suggestion finally occurred to me whereby, I think, this connecting link may be made a practical thing, and no longer be in the way of the consummation of this auxiliary to the safety of ocean travel, and the means of taking regular mid-ocean observations the same as on land. For the cable proper I would not have anything unlike cables in general, yet would suggest a galvanised iron-wire cable similar to those used on large derricks, in place of the regular chain as employed by vessels for anchoring, as on the whole I think it would be stronger. But then the matter of the kind of cable in this connection just now is not of much importance, the principal point being now how to construct and lay it so that it will be a practical thing.

Some parties who have thought on this question have suggested the anchoring of an immense buoy, and making of this a huge store-ship, &c. In this place I would remark that I think that a buoy properly shaped and constructed would be better than a vessel, for the reason that the upper portion of the cable could be so arranged as not to interfere with passing vessels. Experts say that the trouble with the buoy and cable would be twofold: first, the great length of chain would require it to increase very fast in size as its distance increased from the bottom in order simply to have sufficient strength to hold itself up. Secondly, this great weight would necessitate a buoy or vessel of such huge proportions as to make the thing as a whole simply impracticable in the way of cost, &c.

Sometimes it may be best to have the strength of a thing concentrated in one support or bearing, but in general the more we divide it up the better; and this would seem to be the idea to follow out in this cable or connecting link.

There would be no trouble in constructing a number of small buoys. So in the place of one huge buoy, which experts say would have to be so large, I would have a number of smaller ones, and these I would have at intervals of

about 250 feet, or thereabout. But the exact measurement of these intervals is of very little consequence at present; they may be more or less, and could easily be determined upon whenever it was proposed to carry the idea into effect, and would depend upon the size of the buoy, weight of cable adopted, &c.

This length, 250 feet, is simply taken in order to illustrate the plan with a little more facility, as most people can understand such things by illustration better than by abstract or technical terms. The depth of the Atlantic Ocean where such anchorages would be required is from 10,000 to 15,000 feet. At 250 feet for a section, this would make from twenty to thirty sections, requiring twenty to thirty buoys. If each buoy had sufficient bearing capacity to support its section of cable, it will readily be seen that the cable will stand as to strength on the same relative proportion and basis as any ordinary cable of 250 feet; so that if the anchor was in water 3 miles deep the strength of chain or cable would be intact for the purpose of holding the vessel or buoy at the surface, as though at any ordinary anchorage.

Many may ask, how are we to get these buoys—all strung, as it were, on this cable—into position? This, at first, seemed as insurmountable as the cable itself, but now it seems the easiest thing imaginable, and, in fact, not more difficult than it would be to effect any deep anchorage. Let the cable be constructed with the buoys all attached at their regular intervals, and in this manner towed to their respective grounds, soundings of which should be taken in advance, in order to determine the necessary length of cable, allowance to be made for the angle at which the cable would lie in the water. When this has been accomplished, secure the anchor and let go, and like any other anchor there would be no trouble in its finding its way to the bottom and taking hold.

When located, these buoys or stations should be manned much after the manner of lightships and life-saving stations, combined with lights, signals, stores, and life-saving implements; and, in addition to this, have regular signal officers stationed upon them, with established communications with the head-quarters on shore *via* the ocean telegraph. Then we could begin to trace storms upon the ocean as well as upon the land, and if for no other purpose it would seem that these stations would pay for themselves.

After having constructed the stations and suggested what could be accomplished by them, the practical mind will

certainly ask how will we pay for them? Even if good, there must be a great many of them in order to have them of any practical value. I propose to follow up the same idea as in regard to the construction—divide up the cost between the nations. All the civilised people of the world are interested in the safety of the travel between the Old World and the New, and it would seem should likewise be interested in the attempt to trace the line of a storm on the ocean as well as on the land, for only thereby can we become as familiar as we should be with the weather of the whole globe.

The great powers, like the United States, England, France, Germany, Russia, &c., should each construct and maintain a certain proportion; and the smaller and more distant powers, like Holland, Italy, Turkey, &c., a smaller proportion each. In order to stretch across the ocean between America and Europe, a contribution of two from each of the larger powers and one from each of the smaller powers would locate them within the comparatively short distance of 150 to 200 miles of each other. We cannot locate ocean accidents or tell just where storms may happen, and then place our buoys or vessels; neither is there an attempt to do this in our life-saving and weather stations on land: that would be simply impossible. It is not proposed either at present to be able to get them close enough to be in the neighbourhood of every accident or on the line of every storm; yet if placed at these intervals I think that they would pay for themselves in the good they would secure to humanity. We read of mighty works done in the past, but when we come to look at them carefully we find them executed by unwilling hands,—a serf class,—all for the mere vanity of those in power, and not for any real good to mankind. Somehow or other the world has always spoken of the present age in a mere hard mechanical way. We have the Stone, Brass, Iron Age, &c., though occasionally we have the more intellectual designation of "Age of Reason," yet I think there is another name by which this age should be known, "Age of Humanity." No age in the world has done so much for humanity at large; sure there are some minor exceptions, but then all ages have had these more or less. I think that we have the least bad and the most good; so, in respect to the numerous things that are done purely out of brotherly love, I think it full time that we call this the "Age of Humanity," and I hope that the benefactors of mankind may go on and never stop, but continue to extend their genial influence from age to age. Here, in this ocean

life-saving and signal service, I think that there is an opportunity for some of our well-disposed millionares like Peabody, Lick, Cornell, and others of their kind, to establish one of these stations in the ocean. I doubt if their money could be put to any better purpose than in helping carry out some such plan for the benefit of Science, and for the additional safety of those who go down to the sea in ships."—*Kansas City Review of Science and Industry.*

IV. AN HONEST CASHIER.

IT is one of the curious things in nature that the animals nearest to man in the order of development are of little or no use to him industrially. There has never been a time when strong races of men have not compelled their weaker brothers to work for them. But, barring the showman and the organ grinder, the meanest of men have not been able to subjugate or enslave their simian relatives. An ancient Arabic proverb accounts for the freedom of apes by the fact that they shrewdly refuse to talk: "well they know that were they to speak they would be made to work; so they wisely hold their tongues."

The proverbial prudence of the monkey appears to fail in a measure, however, in the land of the white elephant. An Austrian resident at the Court of Siam reports that in that country the monkey is trained to fish for crabs with his tail, as comical a pursuit as can well be imagined, except, perhaps, for the worthy and intelligent ape engaged in it, who sometimes gets a "bite" from a monster crab that he is totally unable to land, and falls a victim to the superior weight of his Cancer Ferox, who drags him into the water, drowns, and finally devours him. The Siamese ape is also stated to be in great request among native merchants as a cashier in their counting-houses. Vast quantities of base coin obtain circulation in Siam, and the faculty of discrimination between good money and bad would appear to be possessed by these gifted monkeys in such an extraordinary degree of development that no mere human being, however carefully trained, can compete with them. The cashier ape meditatively puts into his mouth each coin presented to him

in business payments, and tests it with grave deliberation. If it be genuine he hands it over to his master. If it be counterfeit, he sets it down on the counter before him with a solemn grimace of displeasure. His method of testing is regarded in commercial circles as infallible; and, as a matter of fact, his decision is uniformly accepted by all parties interested in the transaction. But, though a true and invaluable servant to his own particular master, it seems that his moral character is not altogether irreproachable. His deplorable passion for fruit renders him the terror of Siamese market gardeners, who find brute force inadequate to restrain him from visiting their orchards, and therefore have recourse to divers and sundry stratagems, one of which is reported to be as successful as it is certainly ingenious. A specially active and enterprising ape is captured and carefully sewed up in the skin of a tiger cat. He is then turned loose in the orchard of his predilection, and straightway clambers, as well as he may, incumbered by an unfamiliar garment, into the branches of a fruit tree among his unclothed fellows. Scarcely do these latter set eyes upon him with all his feline terrors thick upon him, when a dreadful panic strikes them, and they scramble away with piercing screeches and agonised chatterings. Never more do they return to an orchard which they believe to be infested by the deadliest enemy of their race. The startling intelligence is rapidly disseminated throughout the monkey society of the neighbourhood, and the wily gardener enjoys an absolute immunity from depredation for ever afterwards, for the very thought of a tiger cat appals the simian soul, and doubtless the tale of "the awful apparition in Ting-tse's orchard" is handed down in quadrumanous families from generation to generation.—*Scientific American.*

V. OPIUM SMOKING AMONG THE CELESTIALS.

By Rich V. Mattison, Ph.G., M.D.

As one passes through the Chinese quarter of San Francisco he cannot help being sharply impressed with the immense traffic in an article which is seemingly part of the very life necessities of this curious people. We seem scarcely to pass a shop, whether devoted to the sale of

clothing or drugs or groceries, but what we find a notable proportion of the business to consist in the sale of opium. We pass the shop of the merchant, and while one assistant is counting out the gold for a bill of exchange on the Flowery Kingdom, we see another weighing carefully a small portion of the much coveted drug. The jeweller, surrounded by the precious bracelets of nephrite and phrenite, lays aside for the moment the curious golden circlet he is filing, to catch up the balance and poise upon the pan the little horn cup a moment, and again return to his employment. The grocer, surrounded by the many dainties of Mongolian gastronomy, stands under the rows of varnished fowls, balance in hand, dispensing the drug with the most imperturbable gravity and solemnity. As we stand by the half-open doorway on one of those beautiful summer evenings so common to Pacific climes, a young celestial enters the shop to return in a moment laden with his store of dreamy forgetfulness, the absorption of which transports him, in imagination, to his native land, where riding in a gorgeous palanquin, with maidens to fan him and coolies to fly at his slightest wish, he passes into his dwelling by Kin-Sha-Kiang, or the river of the golden sands, where his wife, with the feet of a mouse, brings his tea in golden cups, and so he passes into the arms of Morpheus (or Morphia's meconic embrace), his couch covered with scarlet and silken curtains with fringes of golden strands, only to awake finding himself lying coiled up on a hard board shelf covered with matting, his head upon a block; for now transported by the magic lamp of a private detective we are in the classic precincts of an opium den. To reach it we have passed through many dark, subterranean alleys, through courts of filth and squalor and wretchedness to any other than Mongolian eyes. On either side of the room, which is about sixteen feet square, are accommodations for twenty or more smokers—shelves rising in tiers like the bunks of a steamer's cabin. In the centre is a small table covered with the shells, bowls, cups, lamps and other paraphernalia of a first-class opium den, sustained by liberal patronage. It was early evening, scarcely midnight, and at our right inclined a strong, sleek, almond-eyed native of a foreign land, well known to our guide as one of the most inveterate smokers of the city. Immediately in front of him was a small saucer filled with lamp oil, and inverted over it was a tumbler in the bottom of which (or the apex as it was placed) a small hole was drilled, through which protruded a piece of wick—this being lighted constituted the lamp. By its side lay an oyster-shell containing a

quantity of a dark coloured extract, and on either side a long wire exactly like the knitting needles of our grandmothers, excepting that one extremity ends in a small spoon. The pipe is naturally of interest. The most usual style is that having a shaft of bamboo, resembling somewhat a flute pierced laterally at each extremity, at one of which is fitted a small metal cup in which to receive the bowl of the pipe proper. This bowl is of earthenware or metal, and is about 3½ inches in diameter, convex on both its upper and lower surfaces, the latter ending in a tube of half an inch in diameter and of similar length; this fits into the metal cup of the bamboo shaft. The upper convex surface is pierced in the centre with a metal tube, having a funnel-shaped aperture about one thirty-second of an inch in diameter. The cavity of the bowl, as here exhibited, is of a capacity of nearly a hundred cubic centimetres.

The pipe is filled by taking up on the apex of one of the knitting needles a small portion of the extract, usually from 2 to 5 grains, and holding it momentarily in the flame of the lamp, rotating the needle dexterously meanwhile, then withdrawing it only to repeat the same operation until the extract is dried to light brown colour and of just such consistency that it sticks to the pipe, when, with a dexterous twist, the point of the needle is inserted into the apex opening of the upper convex surface of the bowl, and the needle instantly withdrawn by a rotary motion. This manœuvre places the extract in the shape of an inverted pyramid, with a central opening communicating with the orifice leading into the cavity of the bowl. It is during this evaporation of the extract over the lamp that the cultivated smoker judges of the quality of the opium. If it bubbles up to that delicate shade of light brown, and at the same time gives off the peculiar odour so characteristic to the trained olfactory nerve bulbs of the Mongolian smoker, then is he satisfied of the quality of the extract purchased.

The bowl being filled, it is inverted over the flame of the lamp at an angle of about 45°, and the volatilising narcotic rapidly drawn by a few strong inspirations into the body of the pipe, and so on into the pulmonary cavities. The inspiration thus made is peculiar; it is not only buccal, but more strongly pulmonary. The inspiration is slow and deep and prolonged, until the chest is filled with the narcotic vapour, and expiration then occurs with the mouth closed, and the inspired smoke issuing slowly through the nostrils.

The quantity smoked varies greatly with different smokers, it varying from 30 grains to upwards of 300 or 400 grains at

one sitting, this being from 10 to 100 pipefuls of the extract. The whole process is done in the most methodical manner. The veriest coolie or wealthiest merchant proceeds to arrange his lamp and extract and pipe with a solemn gravity ludicrous to behold. In this grave affair of state, perhaps five, ten, or even fifteen minutes are consumed; then follows an interval of placidity in those unaccustomed to smoking, to be followed by another and another smoke. But we begin to feel almost like opium smokers ourselves breathing so long the atmosphere De Quincy called "the mephitic regions of carbonic acid gas," so we ascend to the upper regions of the street, and realise, as we never have before, the fresh, invigorating influence of the brisk midnight air of the ocean coast.

The above is taken from the "American Journal of Pharmacy." The effects of opium-smoking have been recently tested by N. von Miklucho Maclay during his stay in Hong Kong. The experiment was made at the Chinese Club, where every convenience for smoking opium is to be found. Dr. Clouth, of Hong Kong, took the necessary observations, and his notes are summarised as follows in the "Chemist and Druggist":—Herr Maclay was in normal health, and had fasted 18 hours before commencing the experiment. He had never smoked tobacco. Twenty-seven pipes, equivalent to 107 grs. of the opium used by the Chinese, were smoked in two and three-quarter hours, at tolerably regular intervals. The third removed the feeling of hunger caused by his long fast, and his pulse rose from 72 to 80. The fourth and fifth caused slight heaviness and desire for sleep, but there was no hesitation in giving correct answers, though he could not guide himself about the room. After the seventh pipe the pulse fell to 70. The twelfth pipe was followed by singing in the ears, and after the thirteenth he laughed heartily, though without any cause that he can remember. Questions asked at this time were answered only after a pause, and not always correctly. He had for some time ceased to be conscious of his actions. After the twenty-fifth pipe, questions asked in a loud tone were not answered. After the last pipe had been smoked he remarked, "I do not hear well." Forty minutes later there was a slight return of consciousness, and he said, "I am quite bewildered. May I smoke some more? Is the man with the pipe gone already?" Fifteen minutes later (4.55 P.M.) he was able to go home, and then retired to bed. He woke the next morning at 3 A.M. and made a hearty meal, after his fast of 33 hours. During the

next day he felt as if he had bees in a great hollow in his head, as well as a slight headache. The organs of locomotion were first affected, next came sight and hearing, but Herr Maclay is very positive that there were no dreams, hallucinations, or visions of any sort whatever.

VI. IS ORGANIC VARIATION FORTUITOUS?*

ADMITTING the broad fact that the organic world, like the organic individual, has been produced not by any sudden and arbitrary intervention of supernatural power, but by a gradual course of Evolution, the question remains—What is the efficient cause of such Evolution? Are species, as we find them, due to the mere accumulation of fortuitous changes through an almost infinite succession of ages? Or can we trace "in the inner domain of life" other and more powerful factors than Natural Selection? A profound thinker suggests as such agencies "Habit and Intelligence." By Habit he understands "that law in virtue of which all the actions and the characters of living beings tend to repeat and to perpetuate themselves not only in the individual, but in its offspring. Mr. Murphy's "Habit," therefore, includes what is commonly known as heredity. He considers intelligence "an attribute of all living beings, and coextensive with life." But by intelligence he means "not only the conscious intelligence of the mind, but also the organising intelligence which adapts the eye for seeing, the ear for hearing, and every other part of the organism for its work." It will easily be seen that the inquiry thus opened must be to no small extent a critique of the hypothesis commonly known as Darwinism. But from the majority of writers who have undertaken such a task Mr. Murphy differs most favourably. He is a decided Evolutionist, agreeing with Darwin "in the belief that all species have been derived by descent with modification, probably from one, certainly from a few original germs." He admits Natural Selection to be "a really operative agent—a *vera causa*," but he differs from Darwin and from his direct disciples by contending—and in our opinion with great cogency—that "the process of

* Habit and Intelligence: a Series of Essays on the Laws of Life and Mind. By J. J. MURPHY. London: Macmillan and Co.

Evolution proves the agency of an Intelligent Power, acting through and controlling the unintelligent forces of Habit and Variation, just as all the vital forces act through and control the inorganic ones."

But though thus differing from Mr. Darwin on a fundamental point, our author never attempts to undervalue his high authority and the services he has rendered to Natural Science. Such a passage as the following stands by no means singly in the present work:—"Much is to be said for this theory, as for everything that Darwin has ever proposed." Nor have we any imputation of motives. In this respect Mr. Murphy stands out in contrast, not merely to a number of lesser luminaries, but to a most distinguished biologist whose views on the Darwinian question in many points approximate to his own. In further contradistinction to certain writers on Evolution the author is not a mere man of culture—an outsider who has "read up" the subject, and who then assumes to teach when scarcely qualified to be a learner. On the contrary, he tells us that for ten years he has been thinking, reading, and conversing on the subjects discussed in this volume, and after a careful examination we see every reason to accept his avowal. Of one of the non-biological critics of Darwinism Mr. Murphy indeed speaks, in our opinion, too favourably. Referring to a somewhat over-rated article in the "North British Review" (June, 1867) he writes—"This is a good instance of the service that an able man may do to a science which is not his own, and of which he does not know the details." Yet in an earlier passage of his work he quotes from the very same article an objection against Evolution almost childish in its character, and based on utter ignorance of the subject under discussion. Concerning this argument Mr. Murphy very justly remarks that it is "one which could not have occurred to a naturalist."

The grounds advanced against the sufficiency of Natural Selection, to account for the origin and characteristics of species, vary greatly in their value. One of the most weighty, recently insisted upon in the "Quarterly Journal of Science" (vol. viii., p. 453), must be sought in the fortuitous destruction which takes place among young animals, quite irrespective of their greater or less "fitness" for survival. Such destruction is fully admitted by Mr. Darwin himself. This difficulty, together with that pointed out by Prof. Tait, may be summarised as follows:—"The final establishment of the superior type is dependent at each step upon three accidents. First, the accident of an individual sort or

variety better adapted to the surrounding conditions than the then prevailing type; secondly, the accident that this superior animal escapes destruction before it has had time to transmit its qualities; and thirdly, the accident that it breeds with another specimen good enough not to neutralise the superior quailties of its mate."

A still more important argument is drawn from structure in advance of function. It is obvious that Natural Selection can only preserve such varieties as are immediately and directly useful to the organism in which they occur. Yet, as Mr. Murphy shows by a number of well-selected examples, there are cases "where structure has been laid down as a preparation for function before the function could be brought into action, as truly as the shipwright when he lays the keel on the land intends the future ship to float on the water." Thus in the metamorphosis of Crustaceans one particular stage—the so-called *Zoea* phase—is characterised by a prolonged abdomen calculated for future utility, though for the time being rather an incumbrance. Elsewhere the author asks, of what use can a dorsal groove and an incipient cartilaginous band be to Ascidian larvæ? Yet, if we regard these creatures as representing the common ancestors of the Vertebrates and Ascidians, we have here the first outlines of the vertebral column essential to the former. The transition from the swim-bladder to the lungs, from the fins to legs with toes, and from the reptile's fore leg to the bird's wing, are also, on the hypothesis of Natural Selection, beset with difficulties. We can scarcely imagine any intermediate stages between the two which would not be useless, even if not positively injurious, to the animal in which they might occur. Mr. Murphy expresses the opinion that this argument is new, and that, if taken up by thorough anatomists and embryologists, "instances of structure in anticipation of function might be found everywhere in the organic world." *

The phenomena of mimetism, or organic mimicry, have generally been considered as affording strong evidence in favour of the Darwinian view. But it is difficult to understand how the first slight variations in the direction of approximating a defenceless animal to some formidable species could be of such essential utility to the former as to ensure its preservation by Natural Selection. A further very formidable difficulty is that the mimicking form is—and if

* A somewhat similar argument, at least as far as concerns the dangers of intermediate stages, may be found in the "Quarterly Journal of Science" (vol. v., p. 329). The instance there given is, however, much less happy and conclusive than the cases adduced by Mr. Murphy.

the mimetism is to be useful must be—rare. Now, according to hypothesis, it is only very numerous species which are likely to yield individuals possessing the required variations. Another difficulty is to be found in the metamorphosis of certain Dipterous insects. Instead of the tissues of the larva being transformed into those of the perfect insect, they seem to be melted down, except at certain spots, into a semi-liquid substance, from which the tissues of the perfect insect are afterwards re-developed. Mr. Mivart bases on this exceptional fact an argument against the all-sufficiency of Natural Selection.

To the contention that geological time is too short for Darwin's theory, few geologists and biologists will attach much importance. The very discrepancies in the calculations of the mathematicians and physicists who have undertaken to fix a maximum limit—discrepancies which are in the proportion of 1 to 40—might provoke a smile.

From all these considerations, and from many others which we cannot here particularise, Mr. Murphy concludes that organic species and their peculiarities are due not alone to the accumulation of fortuitous variations, but to Intelligence. Still he does not hold that the intelligence which directs the formation of organic structures is necessarily conscious, nor that such structures and their adaptations are the direct work of Creative Wisdom: he considers it "more reasonable to believe that organic progress has been effected not by a fresh exertion of Creative Power at every one of the innumerable stages, but by a principle of Intelligence which guides all organic formation and all motor instincts, and finally attains to consciousness in the brains of the higher animals, and to self-consciousness in the brain of Man." He thus, equally with Darwin, avoids making God responsible for the imperfections of the organic world, for the existence of parasitic worms, &c., which on the hypothesis of the Old Natural History "can only be regarded as instruments of torture devised by the Creator, and whose existence no writer of Bridgewater Treatises has yet even attempted to reconcile with His infinite wisdom and benevolence."

An important consideration, which would well repay special notice did space allow, is that the constructive instincts of social insects—bees, wasps, and ants—cannot be inherited in the direct line, because these instincts are possessed by the workers alone, which are non-reproductive. This, however, is only partially correct. Female wasps, humble-bees, &c., especially at the first establishment of a new colony, enjoy none of the exemption from labour which falls to the lot of the queen hive-bee and of female ants,

Mr. Murphy remarks that "neither association nor the principle of imitation will account for the child's use of the word I," and quotes Ferrier's opinion that the use of this pronoun proves not only intelligence, but self-consciousness, which appears to belong to man alone. We have certainly met with no instance of a parrot or other talking bird speaking of itself as "I." But it is interesting to note that young children, before learning to use the personal pronoun, speak of themselves by the same name which is applied to them by others. Just as the parrot which is addressed as Polly connects that word with itself, and if desirous of anything says, *e.g.*, "Give Polly a bit," so the young child addressed as "Baby" speaks of itself as "Baby." This is additional evidence that a child at a certain early age is mentally on a level with the mature parrot, and shows that the difference between man and beast is one of degree rather than of kind.

Incidentally we note that the author considers it possible, "though to our faculties not conceivable, that the number of dimensions in Space may be infinite, though we exist and move in only three." The discussion of this interesting speculation, which seems gradually dawning on the human mind, must be left to mathematicians.

On p. 571 of Mr. Murphy's work we find an assertion with which we are unable, without certain reservations, to agree. We read that "the more highly organised among organisms grow to the largest size and live the longest." We fully admit that the Vertebrata are as a class more highly organised, longer-lived, and larger than the Evertebrates; but the birds, and probably reptiles and fishes, though less highly organised than the mammals, appear to live longer; and even within the mammalian circle, man and the anthropoid apes, though unquestionably the most highly organised, take but an intermediate rank in stature.

Dr. Beale's argument—not against Darwinism, but against Evolution in general—that the microscopic and chemical characters of species are less variable than their external features, requires an amount of attention which it has not yet received.* Mr. Murphy very properly declines to pass any definitive judgment on the question.

It will not be irrelevent for us to pronounce our conviction that "Habit and Intelligence" will amply repay a close and critical study, and that the eighteenth chapter in particular points the way to a field of research not to be neglected.

* BEALE'S edition of TODD and BOWMAN'S Physiology, p. 41.

VII. THE SCIENCE OF AGRICULTURE.

IT is now, we suppose, universally admitted that agriculture, in order to be progressive and profitable, must be conducted on scientific principles. To attain this end and to meet the demands of an increasing population the United States Government has for a long time included a Department of Agriculture, the main object of which is "the introduction of all the productions of the earth that can be grown in any part of the country, and to encourage by every means that diversity of production which is at once the safety and the wealth of the nation." From the Prefatory Report of the Commissioner of Agriculture for 1878 we learn that experiments were made during last season on the growth of different varieties of sugar cane. As far as the experiments go a variety of cane from Jamaica, called the "Salangore," is shown to be worthy of extensive introduction and trial. The attention of the Commissioner has, however, of late been more especially given to the question of producing large supplies of sugar from sorghum and maize. He procured as much as possible of the pure well-cured seed of a variety of sorghum called the "Minnesota Early Amber," and distributed the same in every Congressional district in the United States. The results of this distribution have been most favourable, and the variety has yielded everywhere a large amount of rich saccharine juice, which under proper treatment gives excellent sugar and syrup, the yield being from 120 to 250 gallons of heavy syrup to the acre. It is proposed another season to make experiments with the different varieties of maize and sorghum, and to ascertain the different modes of cultivation and the stage of growth at which the production of sugar is at its maximum, in order that with as little delay as possible the country may be prepared with all necessary data to enter intelligently upon this new industry.

The great drawback to the work of the Department seems to be the want of a larger chemical laboratory with a sufficient appropriation to meet the expenses of the additional force that will be necessary to carry forward investigations on a larger scale than the present laboratory and appliances will permit. With the facilities of the existing laboratory much information which skilful chemical analysis can only

determine is, remarks the Commissioner, necessarily withheld from the farmer and the manufacturer. The report contains extracts from letters from prominent agriculturists in the United States, all of whom testify to the fact that the agricultural interests of the country would be greatly advanced by a more thorough analysis than has yet been made of the grains, grasses, and edible roots, in order to determine the exact value of each in the production of milk, beef, and fibre, or muscular power.

The English Government would do well to follow the lead of the American Government by establishing experimental agricultural stations in various parts of the kingdom with properly furnished laboratories and experienced chemists. It is impossible to over estimate the benefits to agriculture in England resulting from the scientific experiments made on a large practical scale by Messrs. Lawes and Gilbert at Rothamsted, but we contend that such work ought not be left entirely to private enterprise.

In the preface to the English translation of his Lectures on Chemical Manures* at the Experimental Field at Vincennes, M. Georges Ville remarks that it is important that both England and France should be alive to the fact that the agricultural crisis from which both countries are now suffering, as well as the more serious troubles which threaten civilised nations, are only the prelude to the economic struggle between the Old World, bound in the trammels of tradition, and the New World, pressing onward free and unrestrained in the path of progress.

At a period when the means of communication had not reached the development which they have since acquired, the home markets provided certain and easy outlets for agricultural produce. But at the present time, with free trade and the facilities of transport, farmers are compelled to compete in our own markets with all the world. In order that the struggle may be possible and remunerative, it is absolutely necessary that crops of every kind should be increased to their utmost possible limit. The traditions of the past are not sufficient for the necessities of the present. We want more rapid, more economical, and more powerful processes. The agriculturist used to divide the land into two nearly equal parts, setting one aside for grazing pur-

* On Artificial Manures, their Chemical Selection and Scientific Application to Agriculture. A Series of Lectures given at the Experimental Farm at Vincennes during 1867 and 1874-5. By M. GEORGES VILLE. Translated and Edited by WILLIAM CROOKES, F.R.S. Illustrated with Thirty-one Engravings. London: Longmans, Green, and Co. 1879.

poses, or for growing forage plants, and reserving the other for cereal crops, which was equal to asserting that in order to grow cereals there must be meadow land, cattle, and manure. Instead, however, of growing meat in order to have corn, he must grow corn for profit's sake in the first place, and afterwards for straw, cattle-feeding, and manure.

The object of the farmer, then, should be not to produce manure, but to manure his land more abundantly than formerly. No matter what may be the material he employs, whether it be farmyard or chemical manures, used either together or separately, he must somehow or other give back to the soil a larger amount of fertilising material than that lost by the growth of the crops. In the cultivation of the soil increase of production depends less on the worker and on the quality of the tools which he employs than upon the quantity of fertilising materials which he has at his disposal. According to M. Ville the only way to do this is to employ chemical manures, and to prove his assertion, to show that with chemical manures large crops may be quickly obtained from the most barren lands, he refers among others to an experiment carried out by M. Ponsard, President of the Agricultural Committee of Omey in Champagne, on a piece of waste land in one of the most barren districts of a proverbially barren portion of that province. M. Ponsard manured one half of the ground with about 32 tons of farmyard manure per acre, and the other with about half a ton of chemical manure per acre. With the farm manure he obtained 14 bushels of wheat, whereas with chemical manure the land yielded about 30 bushels, there being a loss of £19 in the former case and a gain of £17 in the latter.

Similar experiments have been made with beet-root, potatoes, sugar-cane, &c., and in each case the results have been in favour of the chemical manure. In fact, by varying the quantity of the ingredients entering into the composition of chemical manure, so as to suit the requirements of each class of plants, the work of vegetation may be regulated almost like a machine, the usefulness of which is in proportion to the fuel it consumes. The first point is to discover the degree of richness of the natural soil, and then to ascertain the dominant constituent of each plant. Plants are divided into three categories—first, those in which nitrogenous matter is the dominant constituent, such as cereals, hemp, colza, beet-root, and general garden stuff. The second group, in which calcic phosphate preponderates, comprises maize, sugar-cane, Jerusalem artichokes, turnips, and sorghum. The third group includes leguminous plants,

such as clover, sainfoin, lucerne, potatoes, and vines, and in these potash is the dominant ingredient.

Now what M. Ville terms "normal manures" contain calcic phosphate, potash, lime, and nitrogenous matter, differing only in the respective proportions of these four substances. By varying, therefore, their relative proportion according to the necessities of the particular plants for which they are required, the principle of dominant constituents can be applied to every possible condition which may arise, thereby meeting the requirements and advancing the interests of every description of farming.

It is not necessary to restore to the soil, weight for weight, constituent for constituent, all that is taken from it, but the four constituents named above are essential, and must always be added. Analyses of farmyard manure show that it contains the four constituents which it is essential to restore to the soil, but it also contains carbon, hydrogen, and oxygen; also sodic chloride, magnesia, soda, silica, ferric oxide, &c., all of which are abundantly contained in the poorest soils, and which do not therefore increase the value of manure. Farmyard manure therefore owes all its efficacy to the four essential constituents mentioned above. But we have just shown that each of these constituents with regard to the three others fulfils functions that are in turn subordinate or predominant, according to the nature of the plants to be grown; with farmyard manure, however, there is no possible division; its composition cannot be varied. The only alternative, then, is to use it in conjunction with chemical manures. In practice the quantity of farmyard manure usually applied to an acre of land is, we believe, from 16 to 20 tons, in which quantity the four essential constituents form only about a fortieth of the whole mass. Their proportions are as follow:—

Nitrogen	181	lbs. per acre.
Potash	164	,,
Phosphoric acid ...	98	,,
Lime	352	,,

To place the land under the proper conditions for high cultivation the amount of the fertilising substance in the farmyard manure must be at least doubled by means of chemical manures, and in the case of each particular plant it is necessary to concentrate that chemical agent which is especially favourable to its growth. It must also be remembered that one-third of the nitrogen is lost to the soil on

account of the decomposition which the manure must first undergo before it can exercise its action.

M. Ville strongly advocates the foundation of experimental fields. They are, he affirms, the only reliable method of ascertaining with certainty the composition of the soil with respect to the requirements of agriculture. A piece of land should if possible be selected which in its physical nature and degree of fertility represents the average quality of the land that is to be cultivated. For a newly-worked farm the field should consist of twenty plots, each containing about four poles, arranged in two parallel rows of ten plots each. The first row should be devoted to the cultivation of wheat, and the second to that of beet-root or potatoes, according to the climate and the wants of the district. The wheat furnishes indications of the richness of the superficial layers of the soil, and the beet-root of the deeper layers. Full instructions are given respecting the manuring of the several plots. M. Ville also gives directions for establishing experimental fields for agricultural colleges, societies, and for elementary schools. For the latter the plots should be about eleven yards square. By carrying out the advocated system of manuring it will be conclusively established that it is possible to farm without using farmyard manure; that a manure can be and is composed which more than takes its place, and that the action of animal manure is intensified by the addition of chemical manure.

VIII. MEASUREMENT OF POWDER PRESSURES IN CANNON BY MEANS OF THE REGISTERED COMPRESSION OF OIL.

THE determination of the pressure exerted by the elastic gases produced by the combustion of gunpowder is an element of the first importance in the theory and practice of gunnery, and a measure of this pressure is indispensable in all mathematical computations of the effects of gunpowder on the projectile or on the gun.

In 1855, Dr. W. E. Woodbridge conducted some experiments at Washington Arsenal with the view of measuring the powder pressures of fired gunpowder. The results of these experiments were not published by the U.S. Ordnance Department until November, 1878, when some additional experiments were recorded by the author.

It was proposed in these experiments to ascertain the pressure of the gases evolved by the combustion of gunpowder, by including in the cavity within which the pressure should be restrained a piezometer, which, by registering the compression of a liquid contained within it, should afford an indication of the pressure to which it had been exposed.

This instrument, as employed in these experiments, is a small cylindrical vessel of steel, inclosing a quantity of oil destined to receive the pressure of the fluid by which it may be surrounded, through the medium of a piston, which is carried inward a distance proportional to the amount of compression. To the piston is attached a stem of wire, extending inward, on one side of which a fine point is made to press, inscribing, when the piston is moved, a line on the stem equal in length to the extent of its motion.

In preparing the piezometer for an experiment, two items are to be specially observed: it must contain no air, and the "setting," or adjustment of the quantity of oil contained, must be done at the precise temperature the instrument is to have at the moment of firing.

The procedure is as follows:—All the parts are first oiled over their whole surfaces. The adjusting screw is inserted into the body of the instrument, which is then set upright in a socket attached to the middle of a small pan intended to catch any overflow, and is nearly or quite filled with oil, which should be made to flow down the side of the cavity rather than in a stream. The support of the marking-point, quite clean but covered with oil, is now screwed into its place, with the aid of a special implement, described. When this is withdrawn, it will be necessary to replace the oil caused to overflow by its insertion. The barrel is now slowly put in its place and screwed firmly down. The hole in the piston for receiving the stem is filled with oil, the stem screwed in, and the piston inserted in the barrel. The adjusting-screw is loosened a little, permitting the piston to be pressed just below the top of the barrel, and again tightened. The next step is to bring the instrument and its contents to the setting temperature. For this purpose a water-bath (a common wooden pail) was provided; a narrow tin cup, deeper than the bath, and weighted at the bottom

so as to stand upright within it; and a pair of wooden pinchers for handling the piezometer, which instrument could be inserted in them in such a way as to be nearly enveloped and yet to leave the adjusting-screw and piston readily accessible. The piezometer, seized in the pinchers, is placed at the bottom of the cup in company with the tools to be used in setting it, and is covered with a loose wad of cotton. The cup is set in the middle of the bath and surrounded with water, kept as nearly as possible at the desired temperature, for a sufficient time to impart, as nearly as appreciable, the same to the instrument. It is then withdrawn, the screw loosened, the piston depressed a little to a regulated depth with a special tool, the screw tightened, and the piston rotated a few degrees, which completes the setting. The object of this last movement is to inscribe a transverse line on the stem, affording a starting point in measuring the length of the stroke.

Small changes of temperature after the instrument is set are of no consequence, as the oil will of course return to the same volume, and the piston stand at the same place, on returning to the same temperature.

Before placing the piezometer in the hollow plug, a thin leather envelope, kept saturated with oil, is drawn upon it (with the intention of affording protection against the shock of firing), and when inserted the remaining space within the plug is filled with oil, which is retained by stopping the opening through the retaining-ring (which forms the communication with the bore of the gun), with a loosely-fitted disc of cork or leather.

One particular to be noted is the position of the eye of the piston with reference to the line in which the gun will recoil on firing. The metal surrounding the eye occupies a position at one side of the piston's axis of rotation in the barrel, thereby throwing the centre of gyration out of that line; and if that centre be so situated as to fall outside of a plane coincident with the line of recoil, it is evident that the piston will have a tendency to rotation when the gun is fired. It was apprehended that this rotation might interfere with the proper marking of the stem, or accurate measurement of the mark, and for that reason care was usually taken to place the piston in such position that its centre of gyration should be nearly in the plane just mentioned and forward of its axis of rotation.

After firing, the length of the stroke was measured under a compound microscope by the application of a scale divided into thousandths of an inch and capable of being read to ten-thousandths.

The volume of oil subjected to pressure, the area of the piston, and the length of stroke being known, we derive from them the degree of compression. To complete the data for ascertaining the pressure to which the piezometer has been exposed in any given case, it becomes necessary to determine the relation of compression to the pressure required to effect it.

The experiments made for this purpose were conducted with a good deal of care to secure accuracy, and were somewhat elaborate.

The barrel of the compressing pump is of cast-steel, placed horizontally, its exterior diameter being 2·2 ins., and that of its bore 0·7 ins. The piston, which is also of cast-steel, tempered, is forced in and retracted by means of a square-threaded steel screw 1·5 ins. in diameter.

These parts are placed in a strong frame of iron. The screw is turned by means of a ratchet-wheel, which forms its head, and a lever and pawl connected with it. To facilitate the retraction of the piston a crank is attached. Screw-valves prevent, during the alternate movements of the piston, the escape of the liquid through the aperture by which it enters the barrel, and its return from the receiver into which it is forced. A safety-valve of tempered steel, ground to a seat, also in hardened steel, with its graduated lever and weight, is attached to the pump, and serves for measuring the pressures it is made to exert.

A comparison of the pressure of a column of mercury of known height, with the weight on the valve of the gauge required to balance it, was adopted as the most accurate method of determining the relation between the weights to be placed on the scales and the desired pressures per square inch.

The mercurial pressure-gauge consists of a cistern of glass containing mercury, and a series of perpendicular glass tubes attached to a graduated staff and joined continuously together, extending to the height of fifty-two feet. The tubes are so connected with the cistern that by pressure upon the surface of the mercury it may be forced to ascend the tubes.

In computing the pressure of the column, its height from the surface of the mercury in the cistern was taken, and the counteracting pressure of the weight of the oil by which the pressure was applied was allowed for in proportion to its height and specific gravity.

To ascertain the compressibility of oil in steel piezometers, it was filled and set in the same manner as for use in the

gun. The receiver was immersed in a water-bath kept at the proper temperature. The pressures, temperatures, and lengths of stroke are given below :—

Compression of Oil in Steel Piezometer.

Pressure. Per square inch. Lbs.	Length of stroke at— 60° In.	50° In.
10,000	0·2148	0·2401
15,000	0·2780	0·3266
20,000	0·3656	0·4108
25,000	—	0·5670

We now arrive at the experiments in which the piezometer was used to record the compressions produced by the pressure of fired gunpowder under various conditions, and from which the pressures were to be derived. They were made at Washington Arsenal, D.C., commanded by Major Alfred Mordecai, who heartily co-operated in their conduct.

Two six-pounder guns, one of iron the other of bronze, were used in these experiments. The diameter of the bore of each, at the seat of the shot, was 3·69 ins., very nearly. The iron gun was used in the first three experiments, in which the piezometer was attached to the bottom of the bore. It was afterwards pierced through its side to receive the piezometer inclosed, as described in the Report, in a hollow steel plug, the centre of the opening being 1·5 ins. forward of the bottom of the bore. It was used in this form in several experiments. The bronze gun was, however, used in the greater number. It was pierced with nine holes at different distances from the bottom, beginning at 1 inch and ending with 47·8. They were arranged alternately to the right and left of the central vertical plane, in the upper half of the gun, and inclined 45° to that plane.

A solid plug was fitted to each hole, and was withdrawn only to permit the insertion of the piezometer.

Small holes to receive a thermometer with an elongated bulb were drilled near the openings, mentioned above, extending to within a short distance from the bore.

Several experiments were made to ascertain pressures in a musket barrel. A portion of the bore at the breech-end was enlarged enough to receive the piezometer, and was separated from the forward portion by a ring screwed to place and a leather disc closing its opening, as described in connection with the hollow plug. The piezometer was introduced from the rear, the surrounding space filled with

oil, and the breech-plug inserted afterward. A vent of the normal size was drilled just forward of the partition formed by the ring and disc just mentioned.

It has already been intimated that the temperature at which the piezometer was set was that at which the gun was to be fired. In the earlier experiments the method by which it was intended to effect this was by inclosing the instrument, *ready* to be set, in the gun for a sufficient time to equalise their temperature—which was left to merely atmospheric influences. The instrument was then withdrawn, quickly set, and returned, and the gun fired without delay.

It was afterwards found that the gun changed its temperature sensibly, from changes of wind and sky, in shorter intervals than was supposed. To avoid the errors liable to arise from this cause the practice was changed. The instrument was set at a determinate temperature, higher than that of the outside air, but lower than that of the arsenal workshops. The gun was run into the shops (near by) for a short time in the interval between the experiments, and made slightly warmer than the firing temperature. The piezometer was then properly inserted, the gun taken outside, and when cooled to the proper point the thermometer was removed and the gun fired by a primer already inserted.

The average pressure indicated at different distances from the bottom of the bore, the charge being in each case 1½ lbs. of powder, in a cartridge-bag, and one 6-pounder shot, is given below:—

Distance from the bottom of bore.	Pressure per sq. in.
1-inch (bronze gun)	20,210 lbs.
1½ ,, (iron gun)	18,150 ,,
4 ,, (bronze gun	16,510 ,,

The capability of the piezometer to measure pressures of much more brief duration than the time of the passage of the ball through the barrel will appear from a comparison of the inertia to be overcome in each case. The weight of the piston and stem is 20 grs., and the resistance of the inertia of the oil is equivalent to that of about 36 additional grs., while the weight of the pistol ball is 218 grs. After taking into account the differences of area and the mode of action in the two cases, I think it may be safely concluded that the piston will have reached its extreme position as soon at least as the ball has passed through the same distance.

The superior practical importance of determining the *greatest* instead of the *average* pressure upon the sides of the

bore, with reference to the construction of guns, is evident from the fact that the strength of the gun must be adapted to the former and not to the latter. The inadequacy of the mode of determining, even relatively, the amount of pressures of very brief duration by the initial velocities of balls projected by them is shown by the effects of detonating powders used in fire-arms: the barrel may be shattered while the ball is thrown with comparatively little force.

The effect of increasing the charge of powder, compared with that of increasing the weight of the projectile, in augmenting the pressure was unexpected, and has to some seemed almost incredible; although, as is not surprising in regard to a subject of such a nature, opposite views are held by men thoroughly conversant with artillery.

	Lbs.
The mean of the pressures indicated at 1 inch from the bottom of the bore, with a charge of 1½ lbs. of powder and a ball weighing, with its sabot, 6·3 lbs. nearly, was	20,210
With the same charge, at 1½ ins. from the bottom	18,150
With 1½ lbs. powder and a shot weighing 12·15 lbs., at 1½ ins. from bottom...	20,743
With 2 lbs. powder and a ball of 6·36 lbs., at 1 in. from bottom	20,640
With 3 lbs. powder and a ball of 6·43 lbs., at 1 in. from bottom	22,220

The pressure in the cases in which shot of 12·15 lbs. weight were used, reduced to that which would be indicated at 1 inch from the bottom of the bore, on the supposition that the same difference would exist as with the smaller charges, would be 22,700 lbs., indicating that the effect of doubling the weight of the ball (but with diminished windage) is not very different from doubling the weight of the powder —instead of increasing the pressure in a much greater ratio, as some have supposed.

The results of the experiments with the musket barrel accord, so far as they admit of comparison, with those just stated. The manner in which an increased charge of powder may be supposed to affect the pressure has already been referred to. The resistance of the forming gases in that part of the charge which is least confined, to the expansion of those in other parts of the charge, is perhaps most strikingly illustrated by the action of the fulminates, which, in quantities of a few grains, will, as is well known,

tear in pieces a brass or copper plate upon which they are gently heated.

The variations of pressure sustained by the gun when fired with charges very nearly the same are greater, as might be expected, than the variations of initial velocity imparted to the ball under similar circumstances.

When the combustion of the powder takes place with more than average rapidity, the pressure in the first instants of the explosion is augmented, but its action on the ball is not so well sustained as in the case in which the combustion is more slow and consequently longer continued.

In an article "On the Pressure of Fired Gunpowder in its Practical Applications," in the "American Journal of Science and Arts," September, 1856, Dr. Woodbridge, after reference to the experiments of Count Rumford, who estimated the pressure of gunpowder fired in a space which it filled at not less than 54,750 atmospheres—from an erroneous estimate of the strength of his eprouvette, which was burst by the charge—gives the following experiment, which seems to show that the extreme force of gunpowder fired in small quantities does not exceed 6,200 atmospheres:—"I inclosed in a hollow cylinder of cast-steel, $1\frac{1}{8}$ ins. in exterior diameter and one-fourth of an inch in diameter interiorily, 20 grs. of Hazzard's Kentucky rifle powder, which filled loosely the cavity. This was fired by a flash of powder penetrating through the aperture of a valve (of steel) opening inward, but designed to prevent the escape of gas outward. The cylinder was not ruptured, and, being put under water, no gas was found to escape; (the weight of the instrument was too great to test the loss of gas by my scales.) On pressing in the valve by means of a screw, an abundance of gas escaped, carrying with it the odour of sulphuretted hydrogen. The seat of the valve was found to remain perfect; a fact which, when compared with a former trial in which the gases escaped in consequence of a slight defect of the valve, is presumptive proof of its immediate action. The residuum was found to weigh 10·45 grs. The calculated strength of the cylinder would be equal to an internal pressure of about 93,000 lbs. per square inch, or 6,200 atmospheres of 15 lbs." Dr. Woodbridge regards the method of ascertaining powder pressures by the registered compression of a liquid as capable of greater accuracy than those which are based upon indentation or other change of form in pieces of metal acted on by a piston receiving the pressure to be measured.

NOTICES OF BOOKS.

Rhymes of Science: Wise and Otherwise. New York: Industrial Publication Company.

We have here a collection of poems referring to Science chiefly from a sarcastic point of view. There is "Sir Thomas the Good," extracted from the "Ingoldsby Legends;" there is the well-known "Society upon the Stanislow," and various other effusions of a kindred stamp. There is not, however, Peter Pindar's account of the insect-hunting adventures of Sir Joseph Banks, which we should strongly recommend to the compilers if they feel disposed to produce a companion-volume. The weak side of such verses is that their point, and even their very intelligibility, depend on allusions which are soon forgotten. Thus we can understand that the "De Sauty" of Dr. O. W. Holmes treats of the first laying of the Atlantic telegraph-cable. But what "Cyano-Rhinal" or "Ceruleo-Nasal" can mean is a mystery. We should take them to be "pet names" for that most disreputable of Primates known as *Cynocephalus mormon*. Again, we have the translation of a song given at the concluding dinner of the convention of German physicians and naturalists, headed "Science on a Bender." The allusion here escapes us. "Jim Green" is a rhyme of finance rather than of science.

Notes on Building Construction, arranged to meet the Requirements of the Syllabus of the Science and Art Department of the Committtee of Council on Education, South Kensington. Part III. Materials.—Advanced Course and Course for Honours. London, Oxford, and Cambridge: Rivingtons.

We have here a wonderful collection of information,—geological, chemical, physical, and even to some extent botanical and zoological,—together with much lore not falling within the boundary-lines of any of the sciences, the whole having a bond of unity in the fact of its being necessary for builders and architects. The author, whoever he may be, and the publishers must be congratulated, at least as far as we are able to judge, on the general accuracy of the work. The only questionable statement we have found is in the chapter on Pigments, where Persian red is stated to be a "chromate of lead, produced by boiling white

lead with a solution of bichromate of potash." The colour we have met with under this name is a compound of stannic acid and chrome, much more stable than any lead chromate, and approaching a madder-lake in its shade. Trade names, however, are used with such latitude that we should hesitate to pronounce the passage quoted to be erroneous.

A peculiarity of this book, if we consider the especial purpose for which it is written, is the retention of the "old" chemical nomenclature, for the very satisfactory reason that it is more generally intelligible. We should have thought, however, that South Kensington would have been prepared to fulminate the greater excommunication against the luckless wight who in these days should speak of carbonic acid as a constituent of the atmosphere.

We should consider the work an admirable manual of reference for builders, but the demands made upon the verbal memory of the unfortunates who have to be examined in it are simply fearful to contemplate.

An Introduction to the Systematic Zoology and Morphology of Vertebrate Animals. By A. MACALISTER, M.D. Dublin: Hodges, Foster, and Figgis. London: Longmans and Co.

BORROWING Earl Beaconsfield's critique on the poetry of Mr. R. Browning, we might couple with our appreciation of the merits of this work the wish that some good soul would translate it into English. Let us suppose it placed in the hands of a man well versed in the science of zoology as taught in the middle of the present century, but who had spent the last twenty years on some desert island. He would naturally expect to find that many new discoveries had been made, and that many notions accepted in his day had been given up. But to what extent such changes in the matter had taken place he would be unable to detect, on account of the still greater and more obtrusive revolution in the manner. He would find himself hopelessly lost in a fire-new terminology. Biology has not, indeed, like chemistry, given names of ten and twelve syllables in length to the individuals she describes. No one, fortunately, has yet conceived the idea of making the generic and specific names of an animal or plant embody its supposed line of descent. All this will come by-and-bye unless a vigorous stand be made. But for groups and classes of higher rank than genera, as well as for the parts of animals and for their structural attributes, the names selected are needlessly long and gratuitously un-English. We always presume that in every branch of natural science the great object of the teacher should be to concentrate the attention of the

student upon the facts, the phenomena described, and for that very reason to burden his memory as little as possible with words. Too many professors seem to be of the very opposite opinion. The slightest excuse is enough to justify the introduction of a new term. This tendency is particularly to be regretted in the present day. The division of labour, which has rendered such invaluable services in the industrial arts, assuredly must and will extend to the realms of science and learning. We have already numbers of eager students in biology who know "little Latin and less Greek," and their number will assuredly increase. Why, then, should treatises be written which such men cannot understand—if at all—without great loss of time? Prof. Macalister—who is neither the only, nor perhaps the greatest, sinner—seems conscious that his terminology is open to criticism. He remarks, in his Preface, that it is "impossible to write a strictly scientific treatise in popular language without increasing its bulk proportionally." Had we time we think we could undertake to render his book, not indeed into "popular language," but still into language such as a mere English scholar, guiltless of Greek, would clearly understand, and that without increase of bulk. Take, for instance, two ugly neologisms, arctiodactyl and perissodactyl—why not say simply even-toed and odd-toed? Here, by using plain English, we economise space without sacrificing intelligibility.

Birds of the Colorado Valley. A Repository of Scientific and Popular Information concerning North American Ornithology. By ELLIOTT COUES. Part I.—Passeres to Laniidæ. Washington: Government Printing-Office.

WE have here the first part of a most valuable work—one of the many collateral publications issued in connection with that wonderful undertaking, the United States Geological and Geographical Survey of the Territories. The author describes fully the structural characteristics, the habits, the geographical distribution, and the synonymy of every bird-species known to occur in the Colorado Valley. The region in question corresponds approximately with the "middle faunal province" of some authorities. It is bounded on the east by the main water-shed of the Continent, the Rocky Mountains, and of the Sierra Nevada on the east. Its northern limit is the Salt Lake Valley, and to the south it fades gradually into the great Neotropical region, many of its characteristic forms being still traceable on the table-lands of Mexico. The district offers wonderful variations of climate and surface, and altitude—as the author remarks—does the work of latitude. The characteristics of the work are accuracy and

thoroughness; its only defect, in our opinion, is a disposition to indulge in irrelevancies, as may be seen in the essay on the Catbird, very pleasant reading though it be.

The chapter on Swallows is admirable. The question whether certain individuals of the various species of this group, and of the swifts, do not occasionally hybernate, is discussed at great length; and the author, whilst fully admitting that the vast majority of these birds migrate, does not feel able to refute the evidence in favour of a minority passing the winter in northern climates in a state of torpor. The literature of this subject, chronologically arranged, extends to more than twelve pages, but curiously enough no mention is here made of Gilbert White, who repeatedly refers to the subject in his "Selborne."

The architecture of the swallows is also considered at some length. The interesting fact is brought into due prominence that, with one possible exception, all the species have modified the structure of their nests in accordance with the novel facilities afforded by the settlement of the country. The case of the common European house martin is still more instructive, since within the last fifty years it has changed the shape of its dwellings, not in accordance with any modification in the character of the site selected, but simply with a view to increased convenience.

Dr. Coues considers that the original and typical colour of the eggs of swallows, like those of hole-diggers in general, was a pure white, but that they have gradually become speckled as the nesting-habits of the bird have undergone modification.

Swallow-shooting the author denounces with just severity, and he sympathises warmly with these amiable and useful birds in the defensive warfare they are now obliged to wage against those "wretched interlopers" the European sparrows, whom some wrong-headed acclimatiser has, it appears, rashly introduced into America. We hear with regret that the same blunder has been repeated in Australia. Whilst upon the subject of acclimatising it may not be deemed an unpardonable digression if we record our disgust at learning that an Expedition, which ere this has doubtless sailed from Australia to New Guinea, is about to introduce goats into that country—for the purpose, we presume, of destroying its magnificent flora.

Space will not permit us to extend any further our notice of this work, which we must pronounce a sterling contribution to zoological science.

Proceedings of the Literary and Philosophical Society of Liverpool. Sixty-seventh Session, 1877-78. No. XXXII. London: Longmans and Co. Liverpool: D. Marples and Co. (Limited).

We have on former occasions noticed with regret that in the "Proceedings of the Liverpool Literary and Philosophical Society" science plays a part somewhat similar to that of the "one halfpenny worth of bread" in Falstaff's tavern bill. It might, indeed, have been hoped that under the successive presidencies of the Rev. H. H. Higgins and Dr. Drysdale, both of whom have honourably won their spurs in biological research, a better day might have dawned. Such, however, is not the case. A little work has, indeed, been done, and is noticed in the reports of the successive meetings. Thus Mr. T. Higgin, F.L.S., communicates an interesting notice of a fresh-water sponge (*Spongilla coralloides*) from the rapids of the River Uruguay. Mr. E. D. Jones, a corresponding member, residing at Sao Paulo, in Brazil, is making good progress in recording the metamorphoses of the Lepidoptera of the district: he has observed a caterpillar, belonging to the Bombycidæ, which, if annoyed, utters a low but distinct musical sound. Of fifty species of caterpillars which he has examined, twenty at least possess venomous spines: one of these, a very hairy species, of a bright orange, when applied to the back of the hand produced a most intense pain, which lasted for more than twelve hours, and extended to the arm-pit.

Mr. F. P. Marrat briefly describes a collection of shells from Fuca Straits and Cape Flattery, presented to the Liverpool Museum by Dr. D. Walker.

Mr. T. Higgin communicates notes on the polypidom of the Hydractinidæ, which attach themselves to the calcareous shell of a mollusk, and by some unknown process convert it into a skeleton for themselves.

Mr. J. Roberts describes the geological results of the borings at East Hoyle Bank, and the Rev. H. H. Higgins enters into some speculation on the peculiar structure of the jaws of *Angosoma Neptunus*.

When we turn, however, to the *pieces de resistances*, the papers selected for publication in full and forming the body of the volume, we find not even one composed of the results of experimental research or original observation.

The Presidential Address on the question "Is Scientific Materialism compatible with Dogmatic Theology?" has already come under our notice.*

* See Quarterly Journal of Science, vol. viii. (N.S.) p. 133.

A paper—or shall we say a sermon—in reply, by Mr. J. A. Picton, entitled "On Scientific Materialism from a Non-scientific Point of View" contains a very remarkable utterance:—"If there is one point more than another insisted on by Evolutionists it is the denial of the possibility of miracles." Would Mr. Picton be surprised to learn that the ablest reply extant to Hume's attempted demonstration of the impossibility of miracles is from the pen of one of our most eminent English Evolutionists? Perhaps, however, the word "Evolutionist" is used in some special—perhaps local—acceptation. This is the more probable because in a paper by the Rev. H. H. Higgins, entitled "Developmentalists and Evolutionists, or the Use of Dogma in Science," we find the term "Evolutionist" used in a sense which we never met with before, and which we cannot for one moment accept. It has been used as the common generic name, including alike Messrs. Lamarck, Darwin, Wallace, Haeckel, Asa Grey, St. George Mivart, J. J. Murphy, Oscar Schmidt, Leconte, J. J. Allen, Huxley, Spencer, Belt, Bates, and their followers. If this term is taken away and applied to some particular though not very clearly characterised section who are to be distinguished from certain "developmentalists," we have no common name left for all those naturalists who recognise development as opposed to individual creation.

The essays on the Credibility of Venerable Bede, on Amy Robsart, on the Proverbs of European Nations, on Moses Mendelssohn, and on Trevelyan's Macaulay, do not come within our cognizance.

To one, indeed, of these literary papers we feel compelled to refer. Mr. E. R. Russell, in his essay on Trevelyan's Life of Macaulay, gives utterance to these sentiments:—"He never thought it worth while to quit more attractive studies for the blind and groping physicism which now almost monopolises the name of Science. Whatever good it may have done in other directions, physical science has of late discouraged and debilitated moral and historical inquiry, which is of much more value to the world!" It has always seemed to us, as well as to far abler men, that in England at least—on account of the preponderant attention paid to history, to scholarship, oratory, and polite literature—physical science is neglected, and that by reason of this very neglect we are drifting more and more into the background as compared with some of our neighbours.

The passage we have quoted shows how little sympathy and compatibility exist between literature and physical science, and how injudicious, to say the least, is the attempt to form societies for their joint cultivation. Whereas in England public interest centres in words rather than in things, in criticism and commentation rather than in observation and experiment, literature will always succeed in engrossing more than the lion's share of

time and resources, as the volume before us but too plainly proves.

Practical Hints on the Selection and Use of the Microscope. Intended for Beginners. By JOHN PHIN, Editor of the "American Journal of Microscopy." Second Edition. New York. 1877.

THIS little book will prove of great use to those for whom it is intended. The construction of the microscope is treated in a simple manner, so as not to confuse the beginner. The hints as to the selection of an instrument are very good, and especially adapted to a country like America, inundated with foreign microscopes, good, bad, and indifferent. These remarks will help the student to avoid purchasing what is useless to him.

The portion devoted to manipulative processes is well compiled, the directions plain and easy to follow.

The Chemistry of Common Life. By the late JAMES F. W. JOHNSTON, F.R.S., &c. A New Edition, revised and brought down to the present date, by ARTHUR H. CHURCH, M.A., &c. London and Edinburgh: W. Blackwood and Sons. 1879.

THE late Prof. Johnston had a peculiar talent which is possessed by very few scientific writers. In common with Faraday, Liebig, Tyndall, Huxley, and a few others, he enjoyed the power of being able to clothe the dry bones of scientific fact with the warm and living flesh of lucid exposition and apt illustration.

It is now nearly twenty years since the last edition of Prof. Johnston's work was published, under the editorship of the late Mr. G. H. Lewes. Prof. Church, however, has had a great advantage over his predecessor, inasmuch as he had the opportunity of consulting Prof. Johnston's private and corrected copy of the "Chemistry of Common Life." Little has been added to Prof. Johnston's original work, except in the way of correcting certain figures and statements. Prof. Church has performed his task of revision with great judgment. He tells us in the Preface that he has been compelled to add one entirely new chapter, which no doubt was suggested by the perusal of Prof. Johnston's own notes. It is entitled "The Colours we Admire." In this chapter Prof. Church tells how brilliant colours of all hues have been got out of the coal-scuttle; how chemists have entered into competition even with the great Cybele herself, and have produced alizarin in the test-tube with as great facility as

the faithful goddess herself has done in the madder-root; how copper exists in turacin, the colouring-matter of the beautiful crimson wing-feathers of the touraco, a West African bird, and iron in the hæmoglobin of the blood of mammals. We also have a description of chlorophyll and colein, the latter a colouring-matter discovered by Prof. Church in the leaves of the *Coleus Verschaffeltin*. This chapter might have been extended with great advantage. A copious index adds much to the value of the work.

CORRESPONDENCE.

MENTAL INANITION.

To the Editor of the Monthly Journal of Science.

SIR,—May I ask whether sufficient attention has been paid to the following curious analogy? It is well known that external agencies, such as malaria, make the most prompt and deep impression upon the human body when in a state of inanition. In like manner, objects seen, events witnessed, or words overheard when we are in a state of mental inanition, stamp themselves upon the memory with a permanence out of all proportion to their interest or importance. Thus, having once to walk for about 10 miles through a most uninviting country, on a very dull day, in order to escape the greater evil of waiting for two hours at a railway-station, I saw a butcher washing out an inkstand in the street just outside his shop. It is difficult to conceive a more insignificant occurrence, and yet it has remained as if burnt into my memory. I could give other matters equally trifling, remembered because at the time of their happening my mind was, so to speak, hungry for impressions.—I am, &c.,

S.

THE SEA-SERPENT.

To the Editor of the Monthly Journal of Science.

SIR,—Referring to "Sceptic's" question respecting the Sea-Serpent, in your April number, there is no doubt that Captain Drevar and his mate, of the barque *Pauline*, deposed to the truth of their story, of having seen a sea-serpent, before a magistrate at Liverpool. Capt. Drevar's story is related by the Rev. E. L. Penny, Chaplain to H.M.S. *London*, at Zanzibar, in the "Illustrated London News" for November 20, 1875.—I am, &c,,

M. H. CLOSE.

40, Lower Baggot Street, Dublin,
April 23, 1879.

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY, *April* 3.—"On the Thermal Conductivity of Water," by J. T. Bottomley. The experiments described in this paper were conducted by a method devised by Sir William Thomson. The liquid whose thermal conductivity was to be determined was heated from above, to avoid convection currents. Two methods of heating have been used. In one, a horizontal steam chamber was applied at the top of the water or other liquid, and, steam being continuously passed through the heating chamber, the surface of the liquid under experiment was kept at a very high temperature, and heat was conducted from above downwards. In the other method a large quantity of very hot water was deposited on the top of a mass of cold water, mixing being prevented by a simple contrivance, and the heat of this superincumbent layer was conducted downwards through the colder water below. The experiments were carried on in very large vessels, or tanks, in order to avoid disturbance by means of loss of heat at the sides. Three principal thermometers were employed; together with a fourth, whose object was merely to show when heat begins to be lost at the bottom of the layer of fluid experimented on. When this loss commences the experiment is at an end. The other three thermometers were used thus:—First there was a thermometer with a bulb 30 centims. long, which was placed vertically, its object being to show the average temperature from top to bottom of the layer of fluid bounded by horizontal planes passing through the top and bottom of its bulb. The rise of this thermometer in any time shows the quantity of heat that has passed into the stratum occupied by it in that time. The other two thermometers were placed with their bulbs horizontal, and one at a known distance vertically above the other. They indicate the temperatures of the layers in which they are placed. Knowing the difference of temperatures of two sides of a stratum of a liquid during any time, and the quantity of heat conducted across the stratum during that interval of time, the thermal conductivity of the liquid can be calculated. The result arrived at by the experiments described is that the thermal conductivity of water may be taken at from 0·0022 to 0·00245 in square centimetres per second. The author has made some experiments on the thermal conductivity of solution of sulphate of zinc. These experiments are now being carried on with the assistance of a grant from the Government Fund of £4000.

"Note on the unknown Chromospheric Substance of Young," by G. D. Liveing, M.A., Professor of Chemistry, and J. Dewar, Jacksonian Professor, University of Cambridge. In the preliminary catalogue of the bright lines in the spectrum of the chromosphere published by Young in 1861, he calls special attention to the lines numbered 1 and 82 in the catalogue, remarking that "they are very persistently present, though faint, and can be distinctly seen in the spectroscope to belong to the chromosphere, as such, not being due, like most of the other lines, to the exceptional elevation of matter to heights where it does not properly belong. It would seem very probable that both these lines are due to the same substance which causes the D_3 line." Again, in a letter to "Nature," June, 1872, Young says, "I confess I am sorry that the spectrum of iron shows a bright line coincident with 1474 (K); for, all things considered, I cannot think that iron vapour has anything to do with this line in the spectrum of the corona, and the coincidence has only served to mislead. But there are in the spectrum many cases of lines belonging to the spectra of different metals coinciding, if not absolutely, yet so closely that no existing spectroscope can separate them; and I am disposed to believe that the close coincidence is not accidental, but probably points to some physical relationship, some similarity of molecular constitution perhaps, between the metals concerned. . . . So, in the case of the green coronal matter, is it not likely that though not iron it may turn out to bear some important relation to that metal?" In 1876 he proves that the coronal line 1474 is not actually coincident with the line of iron. In the catalogue of bright lines observed by Young at Sherman, in the Rocky Mountains, it appears that the above-mentioned lines 1 and 82, along with D_3, were as persistently present as hydrogen, the only other line approaching them in frequency of occurrence being the green coronal line 1474 of Kirchhoff, which was present on ninety occasions out of a hundred. It occurred to the authors that these four lines may belong to the same substance. An analogy in the ratio of the wave-lengths of certain groups of lines occurring in different metals has been already pointed out by Stoney, Mascart, Salet, Boisbaudran, and Cornu; and the near coincidence observed by the authors in the ratios of certain lines of hydrogen, lithium, and magnesium, substances belonging to the same type, combined with a similar ratio in the wave-lengths of the nearly equally persistent lines of the chromosphere, greatly strengthens the probability of the assumption that these lines belong to one substance. The fact that the two less refrangible rays have no representative in the Frauenhofer lines is by no means opposed to their belonging to one substance, since aluminium behaves in a similar way in the atmosphere of the sun; and in the total eclipse of 1875 the hydrogen line *h* was not visible in the chromosphere, but was on the limit between

brightness and reversal; and during the late eclipse the two most refrangible rays of hydrogen were not detected from the same cause.

CHEMICAL SOCIETY, *April* 3.—Mr. G. Attwood read a paper "On a Gold Nugget from South America." In the State of Guayana, Venezuela, a large area of alluvial soil has lately been found to contain gold, and nuggets up to 25 ounces have been discovered within 3 feet of the surface. Numerous gold-bearing quartz veins are found in the neighbouring hills. Quite one-half of these nuggets are covered with a dark brown substance, resembling a silicate of iron. Such a nugget was treated with hydrochloric acid (its weight diminished, after treatment with HCl and NaO, from 304·7 grains to 284·33 grains). The solu tion contained—Silica, 0·12 gr.; ferric oxide, 8·88; lime, 0·15; magnesia, 0·08. The nugget was then treated with caustic soda, and again with HCl. The solution contained—Silica, 4·66 grs.; ferric oxide, 4 60; lime, 0·21. During this process much gold in a finely divided state became detached, and after the treatment the nugget was partly covered with a coating of finely divided gold, of a dull colour. The nugget contained 94·54 per cent of gold. The gold from the quartz veins contains 87·9 per cent gold. From these experiments the author concludes that gold nuggets gradually increase in size, owing to the accumulation of fresh particles of finely precipitated gold. Specimens of these nuggets showing the dark glazed coating were exhibited, including one weighing over 14 ounces.

INSTITUTION OF CIVIL ENGINEERS, *March* 25.—Mr. Bateman, President, in the chair. The paper read was on "The Electric Light applied to Lighthouse Illumination," by Mr. J. N. Douglass, M. Inst. C.E. The author showed the progress of lighthouse luminaries from wood and coal fires to the introduction of tallow candles, fatty oils, mineral oils, coal gas, and electricity. In 1839 experiments were made by Faraday, for the Trinity House, at the Orford Low Lighthouse, with the Bude light, and, in 1862, at the South Foreland with the Drummond or limelight, but the results were not so satisfactory as to lead to their adoption. In 1857 experiments were tried at Blackwall with the electric light, produced by the first magneto-electric machine of Holmes; and on the 8th of December, 1858, the electric light, obtained by Holmes's second machine and a "Duboscq" lamp, was shown on the sea for the first time from the South Foreland High Lighthouse. On the 1st of February, 1862, the Trinity House exhibited the electric light permanently at Dungeness Lighthouse, by Holmes magneto-electric machines and lamps. The works for the production of the light were described, and the first cost and maintenance given. The intensity of the electric luminary was about 12½ times that of the oil

luminary. The cost per unit of light per hour was 0·1165d. for the oil, and 0·1294d. for the electric light. Frequent falling off of the latter light occurred, and the oil light had occasionally to be substituted. Shortly afterwards the French lighthouse authorities established the electric light at Cape La Hève, with the magneto-electric machines of the Alliance Company of Paris. In 1867 Holmes further improved his machine and lamp. Two of these machines and lamps were exhibited by the Trinity House at the Paris Exhibition of 1867, with a dioptric apparatus of the third order. The Souter Point Lighthouse was lighted by electricity in January, 1871. The light was adapted to a dioptric apparatus of the third order. A lower light from the same luminary as the upper one was adopted here for the first time. The optical apparatus for both lights was designed by Mr. James T. Chance, M.A., Assoc. Inst. C.E. A "Holmes" fog trumpet apparatus was also worked from the same engines as the electric light apparatus. The total cost of the works was £18,000. The cost of the electric luminary per candle per hour was 0·056d., being rather less than half of the cost per unit at Dungeness. The maximum intensity of the beam from this apparatus was about 700,000 candles. The Trinity House next established the electric light at the South Foreland High and Low Lighthouses, in January, 1872. The apparatus for the production of the light consisted of two steam engines of 20 effective horse-power, four Holmes's improved magneto-electric machines and lamps, and two dioptric apparatuses of the third order for fixed white light. The cost of the additional works for these lights was £14,800. The intensity of the full power beam from the High Lighthouse was about 20 times that of the old first order dioptric oil light. The relative cost per unit of light was as 100 oil to 30·6 electric. In 1873 the Trinity House adopted, for the Lizard Lighthouses, Siemens's dynamo-electric machine and lamp, and a siren fog signal. These were driven by three of Brown's caloric engines, each of 10 effective horse-power. The cost of the additional works for these lights was £14,936, and the annual maintenance, including interest on first cost, amounted to £2,365 6s. 4d. against £1,016 7s. 11d. for the oil lights. The intensity of the full power beam of each light was about 330,000 candles, being about 211½ times the intensity of the oil light. The relative cost per unit of light was 100 oil to 14·04 electric. The successive improvements in the electric machines, and in the means of driving them, had reduced the cost of the electric light at the Lizard to one-ninth of that at Dungeness, and the quantity of light produced at the Lizard per pound of coke consumed was increased 20 times. The continued growth seaward of the shingle point at Dungeness led to the removal, in 1876, of the original electric light apparatus, and the substitution of a low flashing oil light and siren fog signal for both lighthouses. The author furnished information received

from M. Allard, Director-General of the French Lighthouses, relative to the electric lighthouses at Cape La Hêve and Cape Grisnez, where Alliance magneto-electric machines and Serrin lamps had been adopted. It was intended to exhibit the electric light in the present year in a new lighthouse on the Isle of Planier, opposite Marseilles, and it had been decided to substitute the electric light for the oil light in the Palmyre Lighthouse at the mouth of the Gironde. Some information was also given relative to the electric lighthouses at Odessa and Port Said, these making ten in which the electric light had already been established. The comparative cost and efficiency were shown of lighthouse luminaries produced by all the agents at present employed, viz., oil, coal gas, and electricity. Coal gas, on Wigham's system, was applied to the Howth Bailey Lighthouse, Dublin Bay, by the Commissioners of Irish Lights, in June, 1865, and it had since been extended to seven lighthouses on the coast of Ireland. In 1872 the Trinity House adopted it at the Haisborough High Lighthouse. The additional cost of the works necessary for the introduction of gas at this station was £1,996, and the annual maintenance of the gas establishment, including interest on first cost, &c., amounted to £832 4s. 3d. This light had a mean intensity of 1,173 candles, and a maximum intensity for thick weather of about 2,923 candles. In 1877 the necessary additions were made for lighting the Low Lighthouse (distant 776 yards), by gas from the same works, at a cost of £1,296. The system of Mr. Wigham had been further developed by introducing the flames of two, three, and four large burners over each other in the axis of the dioptric apparatus. In January of last year the Commissioners of Irish Lights adopted one of the latter lights in a new lighthouse at Galley Head, near Kinsale. The maximum intensity of the four burners combined for thick weather was about 5,012 candles. The author next gave statements showing the comparative focussing compactness of the lighthouse luminaries which had been referred to for utilising in optical apparatus, viz., the lights produced by oil, coal gas, and electricity. The focussing superiority of the electric luminary, compared with the best of these, was as 616 to 1. Statements were given of the comparative average cost and annual maintenance of a single lighthouse (shore station) in this country, with colza oil, mineral oil, coal gas, and electricity, as the illuminating agents, both with and without a first-class 20 horse-power siren fog signal. For a maximum degree of light equal to the single or combined intensity of the luminaries of the Lizard, the cost of the more perfect electric luminary per unit of light provided was about 13-22 and 6-22 respectively of that of coal gas, and about 13-65 and 6-65 respectively of that of mineral oil, at their maximum intensities. With higher intensities of the electric luminary the cost per unit would be more in its favour, no further addition to the working staff being

necessary. From experiments by Faraday for the Trinity House, in 1836, relative to the penetrative power of lights, through such obstructions as fog, mist, &c., and the more recent experiments by the French Lighthouse authorities and by the Trinity House, with oil and electric lights, it might be assumed that, with the atmosphere so impaired for the transmission of light, that the oil luminary at its maximum intensity would be fairly visible at the fog signal range of two miles, the electric luminary at its double Lizard intensity of 16,500 candles would be visible at about four miles. Further, that on more frequent occasions, when the oil luminary would be visible at about eight miles and a-half, the electric light would be visible at the full range of 17 miles.

April 22.—Mr. Bateman, President, in the chair.

The paper read was on "Dioptric Apparatus in Lighthouses for the Electric Light," by Mr. James T. Chance, Assoc. Inst. C.E. The author briefly premised that in the Fresnel or dioptric system the source of light occupied the central position within a structure of glass zones, or annular segments, by which the incident rays were condensed and directed on the sea; and that there were two principal kinds of dioptric apparatus, the fixed and the revolving. He then proceeded to make some observations concerning the different optical treatment which a small radiant like the electric arc required from that which suited an ordinary flame; in the latter case, as—for it concerned sea-lights—the object was not only to parallelise all the rays emanating from any point of the luminary, but also to reduce the vertical divergence due to the height of the flame by increasing the diameter of the optical instrument. On the other hand, the smallness of the electric arc afforded the opportunity of obtaining from the dioptric zones or other elements, by suitable generating sections, whatever divergence, whether horizontal or vertical, might be desired. It was also pointed out that the source of light, in the case of the electric arc, could not be entirely depended upon for maintaining the same position in relation to the focal horizontal plane, and that consequently—since the vertical divergence due to the luminary would move upwards or downwards with any vertical displacement of the radiant itself—the mariner could not be absolutely secured from failing to see the light, unless a special vertical divergence were given by the dioptric apparatus, independently of that caused by the size of the electric arc. This, however, involved the adoption for this illuminant of a dioptric instrument considerably larger than what was originally contemplated, so as to reduce materially the luminary divergence, and thereby be free to substitute for it, to some extent, a special vertical divergence. The author stated that in 1862 he had expressed himself in favour of a much larger apparatus than was then employed with the electric light at Dungeness. Also that,

in 1865, Messrs. D. and T. Stevenson had recommended a third order apparatus for the purpose, in their Report to the Commissioners of Northern Lighthouses. A similar result was arrived at by the Elder Brethren of the Trinity House, in 1869, in consequence of comparative trials instituted by Prof. Tyndall, for testing the relative merits of a sixth order light, and a third order one respectively, when used with the electric radiant. The Souter Point revolving light, which was first exhibited in January, 1871, was described. Reasons were assigned for adopting two optical agents—one to condense the light in the vertical plane, the other to produce the required horizontal compression—instead of attempting, even for the refracting part of the apparatus, to effect the two condensations respectively by a single agent. Reference was made to the proposal of Mr. Thomas Stephenson, M. Inst. C.E., for attaining this latter desideratum; as likewise to that of Mr. Brebner, M. Inst. C.E., with a similar object. The method actually adopted was similar to that which had been already employed in France for the revolving light with the electric arc. It consisted of a fixed third order light encircling 180°, and of a rotating octagonal drum of the same height surrounding it. Each side of this drum, comprising three panels in height, was composed of vertical refracting prisms, by which the light, radiating in azimuth from the inner fixed apparatus, was compressed horizontally into a beam of 7° 8′ divergence in addition to that due to the diameter of the electric arc. This was done in such a manner that every single prism had its own independent divergence of the same amplitude, whereby was obtained an extent of light-emitting surface of a height of 6½ feet and of 22½ inches in breadth. Stress was laid upon its being the characteristic feature of the beam issuing from any one of the sides of this glass drum, that, in passing before the eye of the observer at sea, its brilliancy would, from first to last, remain unchanged, as distinguished from the waxing and waning appearance of the ordinary revolving light; consequently, at whatever distance the flash might be visible, the interval of its duration would be the same. Attention was also directed to the valuable suggestion made by Mr. J. N. Douglass, M. Inst. C.E., the Engineer to the Trinity House, that advantage should be taken of the landward hemisphere of the radiant light of the electric arc, to provide a beam which should be made to issue through a window in the tower below the main light, in order to mark certain dangers in Sunderland Bay; and it was stated that 54·6 per cent of the rearward hemisphere of light had been thus utilised. The two fixed lights which were inaugurated at the South Foreland, in January, 1872, were described. It was explained how the whole of the catadioptric zones, both upper and lower, were in both lights made to parallelise the rays in the usual manner. The light, however, incident on the refracting portion of each light was distributed over the sea from the horizon to within a

short distance from each tower, by a succession of increasing angles of vertical divergence, so that the illumination of the sea became gradually diminished as the distance from land was lessened. In each light there was a rearward arc to spare, and this was turned to valuable account, from 67 to 71 per cent of this light being collected and acted upon by optical agents, which were particularly described, and thereby distributed uniformly over the front azimuthal arc, so as to intensify not only the illumination of the horizon and the distant sea, but also that of the nearer sea. It was mentioned that the two Lizard Lights, which were both fixed, and were first exhibited in March, 1878, had optical arrangements similar in every respect to those adopted at the South Foreland Lighthouses, with a slight variation in the refracting portions, arising from the circumstance that existing apparatus had to be turned to account in the construction of each apparatus. A table was appended, showing the condensing powers in the direction of the horizon of the lights described in the paper, distinguishing those optical portions which parallelised the incident light from those which gave to it special vertical divergence. According to this table, upon the assumption that the diameter of the electric arc was 12 millimetres, the condensing powers in the sea-horizon direction were as follow :—

Souter Point—Revolving	236·38
South Foreland—High fixed	50·17
South Foreland—Low fixed	43·40
Two Lizard Lights—Fixed...	58·44

and data were added for adapting this table to particular cases. In a second table was given the respective condensing powers over the near sea, at different distances from the lighthouse towers.

Meteorological Society, *February* 19.—Mr. C. Greaves, President, in the chair.

Among the papers read were the "Diurnal Variations of Barometric Pressure in the British Isles," by Frederick Chambers. The object of this paper is to show that differences of types of the diurnal variations of pressure at inland or sea-coast stations are due to the superposition, on a common type of diurnal variation at all the stations, of a distinct diurnal variation of barometric pressure, such as is required to satisfy the convection-current theory which explains the well-known diurnal land and sea breezes. To show this, all that is necessary is to take the differences of the corresponding hourly inequalities of the barometric pressure at pairs of inland and coast stations, and to exhibit these differences in the form of curves, which are then found to closely resemble the curves of diurnal variation of air temperature.

"On the Relation existing between the Duration of Sunshine, the amount of Solar Radiation, and the Temperature indicated by the Black Bulb Thermometer *in vacuo*," by G. M. Whipple, B.Sc., F.R.A.S. The author has instituted a comparison between the duration of sunshine, as determined by Campbell's sunshine recorder, and the amount of solar radiation, as ascertained from the readings of the black bulb thermometer *in vacuo*, for the year 1877, at the Kew Observatory. It is evident that there is a close relation between these phenomena, but, owing to the great range of the black bulb thermometer, the exact nature of the connection is not immediately evident. The author says that it may be safely concluded that the measure of solar radiation, as given by the black bulb thermometer, is only to be considered at any place as an indication of the relative presence or absence of cloud from the sky at the locality, and so its use as a meteorological instrument may with advantage be set aside in favour of the sunshine record, which has not the elements of uncertainty attached to it, inseparable from the former instrument.

March 19.—Mr. C. Greaves, President, in the chair.

The papers read included one on "Dew, Mist, and Fog," by George Dines, F.M.S. The author has, during the last two years, made a number of experiments to determine the amount of dew that is deposited on the surface of the earth. The plan adopted was as follows:—Glasses similar to ordinary watch-glasses were procured; the surface area and the weight of each was ascertained. These glasses were exposed to the open air in the evening, being placed on different substances, viz., on grass, on slate, and on a deal board, the two latter being raised a few inches above the grass. A minimum thermometer was generally placed by the side of each glass. It is only on rare occasions that an amount of dew exceeding 0·010 inch in depth has been deposited upon the measuring glasses, and out of 198 observations in only three has that amount been exceeded: 58 observations give the amount from 0·010 to 0·005 inch, 107 from 0·005 to 0·001 inch, 22 less than 0·001 inch, and 8 observations no dew at all. The author thinks it may be fairly assumed that the average annual deposit of dew upon the surface of the earth falls short of 1·5 inch. There are two kinds of mist, the morning and evening. The morning mist is caused by the evaporation from the water and the moist ground taking place faster than the vapour is taken away; the air becomes saturated, but this does not stop the evaporation; the vapour continues to rise into the air, is there condensed, and forms mist, which gradually spreads over a wider surface. The evening mist is produced as follows:—The cold on the grass, caused by radiation, lowers the temperature of the air above it; the invisible vapour of water previously existing in the air is in excess of that which the air can retain when the temperature is lowered; the surplus is condensed, becomes a

mist cloud, and floats in the air just above the surface of the grass. Taken either separately or combined, the mists appear to the author totally and altogether inadequate to account for those dense fogs which at times overspread large tracts of country. Dense fogs near the earth are often accompanied by a clear sky above, when the sun may be seen reflected from the gilded vanes of our public buildings. After long consideration the author is inclined to attribute these fogs to some cause at present unknown to us, by which the whole body of the air to some distance above the surface of the earth is cooled down, and as a consequence part of the vapour of that air is condensed, and forms what has been called an "earth-cloud."

"On the Inclination of the Axes of Cyclones," by the Rev. W. Clement Ley, M.A., F.M.S. In this paper the author calls attention to the evidence recently afforded by the results of mountain observations to the theory that "the axis of a cyclone inclines backwards." The author first reviews the state of the question up to the present time, and details his own investigations, chiefly founded upon the movement of cirrus clouds; he then refers to Prof. Loomis's recent "Contributions to Meteorology," in which is discussed the observations at the summits and bases of several high mountains, the results of which fully confirm the theory that the axis of a cyclone inclines backwards.

Royal Institution of Great Britain, *February* 21.—"A New Chemical Industry, established by M. Camille Vincent," by Prof. Roscoe, LL.D., F.R.S. Dr. Roscoe, after referring to the experiment by which ammonia was first obtained by Joseph Priestley in the gaseous state, and to the various ammoniacal discoveries which have been made during the last hundred years, remarked that in the French beet-root sugar industry, as in the manufacture of cane sugar, large quantities of molasses or treacle remain behind after the whole of the crystallisable sugar has been withdrawn. These molasses are invariably employed to yield alcohol by fermentation. The juice of the beet, as well as that of cane-sugar, contains, in addition to the sugar, a large quantity of extractive and nitrogenous matters, together with considerable quantities of alkaline salts. In some sugar-producing districts the waste liquors or spent wash from the stills—called *vinasses* in French—are wastefully and ignorantly thrown away, instead of being returned to the land as a fertiliser, and thus the soil becomes impoverished. In France it has long been the custom of the distiller to evaporate these liquors (*vinasses*) to dryness, and to calcine the mass in a reverberatory furnace, thus destroying the whole of the organic matter, but recovering the alkaline salts of the beet-root. In this way 2000 tons of carbonate of potash are annually produced in the French distilleries. For more than thirty years the idea has been entertained of collecting the ammonia-water, tar, and oils which are given

off when this organic matter is calcined, but the practical realisation of the project has only quite recently been accomplished, through the persevering and sagacious labours of M. Camille Vincent, of Paris. The following is an outline of the process as carried out at the large distillery of Messrs Tilloy, Delaune, and Co., at Courrières. The spent wash having been evaporated until it has attained a specific gravity of 1·31, is allowed to run into cast-iron retorts, in which it is submitted to dry distillation. This process lasts four hours; the volatile products pass over, whilst a residue of porous charcoal and alkaline salts remains behind in the retort. The gaseous products given off during the distillation are passed through coolers, in order to condense all the portions which are liquid or solid at the ordinary temperature, and the combustible gases pass on uncondensed and serve as fuel for heating the retorts. The liquid distillate from the spent wash may be divided into—

1. The ammonia water.
2. The tar.

The ammonia water of the vinasse resembles that of the coal-gas manufacture in so far as it contains carbonate, sulphydrate, and hydrocyanide of ammonia; but it differs from this (and approximates to the products of the dry distillation of wood) by containing in addition methyl alcohol, methyl sulphide, methyl cyanide, many of the members of the fatty acid series, and, most remarkable of all, *large quantities of the salts of trimethylamin*. The tar, on re-distillation, yields more ammonia water, a large number of oils, the alkaloids of the pyriden series, solid hydrocarbons, carbolic acid, and, lastly, a pitch of fine quality. The crude alkaline aqueous distillate is first neutralised by sulphuric acid, and the saline solution evaporated, when crystals of sulphate of ammonia are deposited; and these, after separating and draining off, leave a mother-liquor, which contains the more soluble sulphate of trimethylamin. During the process of concentration, vapours of methyl alcohol, methyl cyanide, and other nitriles are given off, these being condensed, and the cyanide used for the preparation of ammonia and acetic acid by decomposing it with an alkali. Trimethylamin itself is at present of no commercial value, but M. Vincent finds that the hydrochlorate of trimethylamin, when heated to a temperature of 260°, decomposes into (1) ammonia, (2) free trimethylamin, and (3) chloride of methyl, and both ammonia and chloride of methyl are substances possessing a considerable commercial value. The latter compound can be employed as a means of producing artificial cold, and for preparing methylated dyes, which are at present costly, inasmuch as they have hitherto been obtained by the use of methyl iodide, an expensive substance. As a means of producing low temperatures chloride of methyl will prove of great service both in the laboratory and on a larger industrial scale.

When the liquid is allowed to escape from the receiver into an open vessel it begins to boil, and in a few moments the temperature of the liquid is lowered by the ebullition below $-23°$, the boiling-point of the chloride. The liquid then remains for a length of time in a quiescent state, and may be used as a freezing agent. By increasing the rapidity of the evaporation by means of a current of air blown through the liquid, or better by placing the liquid in connection with a good air-pump, the temperature of the liquid can in a few moments be reduced to $-55°$, and large masses of mercury easily solidified. M. Vincent has recently constructed a freezing machine which will probably compete favourably with the ether and sulphurous acid freezing machines now in use, as it can be simply constructed, and as the vapour and liquid do not attack metal and are non-poisonous, the frigorific effects which it is capable of producing being moreover most energetic. The second and perhaps more important application of methyl chloride is to the manufacture of methylated colours. The application of methyl chloride to the preparation of violets and greens is not, however, due to M. Vincent. His merit is in establishing a cheap method by which perfectly pure chloride of methyl can be obtained, and thus rendering the processes of the manufacture of colours much more certain than they have been hitherto. Dr. Roscoe concluded his discourse by referring to this as another instance of the utilisation of waste chemical products and of the preparation on a large scale of compounds hitherto known only as chemical rarities.

NOTES.

Biology.

In a paper on the development of the ovaries in female mammals after birth, read before the Academy of Sciences, M. Ch. Rouget states that his researches have led him to conclusions agreeing with those of Kölliker. His observations support the theory of primordial hermaphroditism.

M. Chatin describes, in the "Comptes Rendus," the special nutritive apparatus of phanerogamic parasites. He finds that the suckers of such parasites are morphologically and physiologically analogous to the roots of ordinary plants.

Sarracenia purpurea contains a proximate principle closely analogous to that of the Colchicaceæ, although belonging to a remote family bordering on the Papaveraceæ.

M. Maxime Cornu points out the existence in the Crassulaceæ of cortical woody bodies agglomerated together, and apparently serving to strengthen the fragile stems destined to support an efflorescence consisting of numerous flowrets.

M. Dareste has observed, in the yolk of egg, certain granules which have generally been supposed to be lecithine, but which in their physical and chemical characters agree rather with starch.

M. Couty has made known the results of observations on the non-excitability of the grey cortical substance of the brain, which, he finds, takes no part in the phenomena produced by exciting the surface of the brain. These phenomena remain the same whether the grey layer is intact or paralysed by an anæsthetic.

M. Arm. Moreau infers, from experiments performed on dogs, that the analogy supposed to exist between the phenomena induced by the presence of certain saline solutions in the intestinal canal and the phenomena which have been studied outside the animal system by the aid of the endosmometer cannot be maintained.

MM. Bergeret and Moreau propose water slightly acidulated with nitric acid as a remedy for the *Peronospora* infesting the lettuce.

M. A. Certes recommends the vapours of osmic acid for the preservation of Infusoria.

According to M. S. Jourdain, in *Arion rufus* the arterial blood issues into the visceral cavity from funnel-shaped orifices at the extremities of the minute arteries, and is afterwards taken up by

the veins, there being—as M. Milne-Edwards has shown to be the case in various regions of the body of the Mollusca—no system of capillaries establishing a continuity between the arterial and the venous systems. Similar orifices exist in many other Mollusca.

According to the "Revue Internationale des Science" a species of tortoise is found in China in which the head, neck, legs, &c., are covered not with scales, but with long and dense hair. The locality of this singular being is a lake in the province of Kiang-su. It is from 7 to 8 centimetres in length, with a prolonged snout, and a tail long and narrow.

Prof. Naegeli, of Munich, maintains that infectious and malarious diseases are due to *Schizomycetes*, which, however, are not all specifically distinct, but represent forms of one, or at most of a limited number of species.

M. P. Arnoux has brought to France a specimen of honey found in certain subterranean cavities in Ethiopia, and said to be collected by an insect "resembling a large mosquito." It is unaccompanied by wax, and differs from ordinary honey by being free from cane-sugar. We can scarcely believe that it is elaborated by a dipterous insect.

M. Ch. Musset has described to the Academy of Sciences a shower of sap which he observed, on the 22nd of August last, falling from two trees of *Abies excelsa*. Clouds of insects had collected to the feast.

M. Jousset de Bellesme has shown that the so-called liver of the Cephalopa presents no functional analogy with the liver of the Vertebrates. It transforms albuminoid matters, but is without action on fatty and starchy bodies. The author has already demonstrated the same fact concerning the liver of Crustaceans, and M. Plateau has reached a similar conclusion regarding the Arachnidæ and Myriapoda.

M. Merget, of Bordeaux, finding that mercurial vapour easily permeates disks of wood, recommends it as a means of studying the structure of vegetable matter. If wood, after exposure to the vapours of mercury, is brought in contact with a sensitive paper (obtained by saturating paper with an ammoniacal solution of nitrate of silver) a distinct design of the fibro-vascular bundles and of the medullary rays will be obtained. We may thus design the stomata of a leaf, and show that in case of those possessing stomata on both surfaces the air circulates from one epidermis to the other.

Chemistry and Technology.

Mr. A. Percy Smith communicates to the "Chemical News" a case of poisoning by arsenical wall papers. A lady in Rugby

complained of a peculiar feeling of constriction in her nose, accompanied by a "nasty smell," nausea, and loss of appetite, and was unable to discover the cause. The symptoms had been felt since sleeping in a certain room, which she had done for two months. Mr. Smith analysed the paper, and found 0·35 grm. As_2O_3 per square foot; but that scarcely represents the total amount, because the paper was wetted in order to remove it, and the greater proportion of the bright green flowers washed off. There was very little copper present. The lady's husband was not affected in the slightest degree.

Writing to the "Chemical News" on the analysis of Australian *Eucalypti*, Mr. R. D. Adams, of Sydney, N.S.W., says that the celebrated *Eucalyptus globulus* is by no means the richest in the essential oil which gives the peculiar sanitary value to this class of trees, although it is the most "taking" in its earlier stages, from the rapidity of its growth and fulness of foliage. It is the *E. amygdalina* which yields more volatile oil than any other tested, and which therefore is largely chosen for distillation; thus it is also one of the best for subduing malarian effluvia in fever regions, although it does not grow with quite the same ease and celerity as *E. globulus*. The respective hygienic value of various Eucalypts may to some extent be judged from the percentage of oil in their foliage, as stated below, and as ascertained by Mr. Bosisto at the instance of Baron Ferdinand von Mueller, Director of the Victorian Botanical Department for the Exhibition of 1862:—

E. amygdalina	3·313	per cent	volatile oil.
E. oleosa	1·250	,,	,,
E. leucoxylon	1·060	,,	,,
E. goniocalyx	0·914	,,	,,
E. globulus	0·719	,,	,,
E. obliqua	0·500	,,	,,

The lesser quantity of oil of *E. globulus* is, however, compensated for by the vigour of its growth and the early copiousness of its foliage. The proportion of oil varies also somewhat according to locality and season. *E. rostrata*, though one of the poorest in oils, is nevertheless important for malarian regions, as it will grow well on periodically inundated places, and even in stagnant water not saline. *E. oleosa* (F. v. M.), from the desert regions of extra-tropic Australia, might be reared on barren lands of other countries for the sake of its oil. According to Mr. Osborne's experiments, *Eucalyptus* oils dissolve the following, among other substances, for select varnishes and other preparations:—Camphor, pine-resins, mastich, elemi, sandarac, kauri, dammar, asphalte, xanthorrhæa-resin, dragon's blood, benzoe, copal, amber, anime, shellac, caoutchouc, also wax, but not gutta-percha. These substances are arranged here in the order of their great solubility. The potash obtainable from the ashes of various

Eucalypts varies from 5 to 27 per cent. One ton of the fresh foliage of *E. globulus* yields about 8½ lbs. of pearlash; a ton of the green wood, about 2¼ lbs.; of dry wood, about 4½ lbs.

In a petition to the Reichstag concerning the use of alleged poisonous colours, the Association for Promoting the Interests of German Chemical Industry point out that certain dyes, such as red corallin and aurantia, denounced as poisons, have subsequently been proved perfectly innocent. They pray that no colour may be prohibited till it has been formally pronounced dangerous to public health by a commission of specially qualified chemists and physiologists after a due scientific examination.

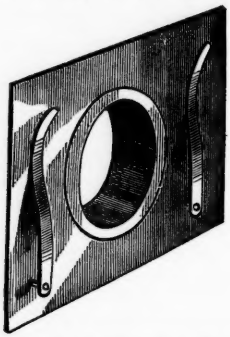
While engaged in preparing a Supplement to his "Handbook of Chemical Manipulation, Mr. Greville Williams, F.R.S., made inquiries with the view of ascertaining what improvements had recently been made in the volumetrical determination of acids and alkalies. Amongst the persons consulted was Dr. Otto N. Witt, who pointed out that the "orange 3" of Porrier formed an excellent substitute for litmus. This new coal-tar derivative was introduced into commerce about two years ago: its manufacture has, however, been almost entirely, if not quite, abandoned in favour of "orange 4" or tropæolin OO. This "orange 3" had, before its introduction into commerce, been studied independently by Dr. Witt and M. Griess; and M. Lunge, in the "Berichte der Deutschen Chemischen Gesellschaft," expressly mentions it as an indicator. Its chemical name is dimethylamido-azo-benzol-sulphonate of ammonium. Different specimens of litmus somewhat vary in their sensitiveness to acids and alkalies; that with which Mr. Williams experimented in comparing "orange 3" and litmus ceased to indicate with sulphuric acid when more dilute than 1 to 50,000. The new indicator, on the other hand, remained sensitive to 1 part of sulphuric acid in 100,000 of water. An immense advantage which this indicator possesses over litmus is that it is entirely unaffected by carbonic acid; the solution need not therefore be boiled, and the operation consequently takes much less time; in fact, four operations can be made in the same time as one with litmus. Mr. Williams also finds that the new indicator can be employed in the determination of ammonia instead of litmus, and has many advantages over it.

M. G. Luvini has preserved the eggs of the silkworm in hydrogen, carbonic acid, oxygen, and nitrogen for about three months. Those which had been kept in carbonic acid and in nitrogen after removal hatched well and gave an almost complete yield.

Physics.

A galvanometer, which measures the strength of the electric current directly, instead of indirectly, as in the instruments commonly employed, has, we learn from the "Engineering and Mining Journal," been constructed by Prof. Dolbear, of Tufts College. He utilises the force exerted by a common helix to draw the core within itself when a current is passed through it, which is directly proportional to the strength of the current. A simple mechanism, consisting of a spiral spring, a graduated scale, and a pointer, suffices to measure the strength of the current.

A simple contrivance for holding the object beneath the stage of the microscope, when extreme obliquity of illumination is required, has been devised by Mr. John Phin, of New York, and has the advantage of being easily adapted to any microscope.



The little sub-stage, with clips attached, is slid into the aperture in the stage. The mode of use will be obvious. Mr. Phin also states that the plan of holding the object beneath the stage is not new, having been invented by Mr. C. A. Spencer about twenty years ago.

Mr. E. J. Newton, of the Quekett Microscopical Club, has constructed an enlarged model of the brain of a cockroach (*Blatta orientalis*). The brain, properly hardened, was cut into sections of 1-1000th of an inch in thickness, and after the sections were mounted a careful outline of each was made by the camera lucida, on a piece of soft pine-wood of suitable thickness. Each slice was carefully cut out with a fine saw, and the whole piled together to form the magnified model. The surface of each section was carefully coloured, after the original preparations, to represent the appearance presented under the microscope.

The "Journal of the Royal Microscopical Society" has completed its first annual volume. The Fellows may be congratulated upon the improved form their official publication has taken. The volume contains 402 pages, comprising the whole of the papers read before the Society, seventeen plates besides woodcuts in the text, full reports of the meetings, translations of

microscopical and biological papers from foreign sources, and a list of similar articles in several British and foreign publications. Mr. Frank Crisp, LL.B., B.A., F.L.S., one of the Secretaries of the Society, has undertaken the honorary editorship.

The Council of the Royal Microscopical Society have devised a plan by which other societies founded for kindred objects should be brought into association with them. The presidents for the time being of such societies, at home or abroad, as the Council may from time to time recommend, shall be *ex officio* Fellows, and shall receive the publications of the Royal Microscopical on behalf of their respective societies, and exercise all other privileges of Fellows, voting excepted. At a recent meeting the Quekett Microscopical Club, the South London Microscopical Club, the Croydon Microscopical Club, and a large number of provincial and foreign societies, were, through their respective presidents, admitted to *ex officio* fellowship.

The microscopic phenomena of muscular contraction has recently been studied by Th. W. Engelmann : the results are given in "Archives Neerlandaises." During the contraction of the transversely striated muscular fibres there are produced, parallel with the change of form of the muscular elements, changes in the optical properties of the isotropic and anisotropic layers. These changes are of an opposite nature in the two layers, the isotropic stratum in its totality becoming more refrangent and the anisotropic less refrangent. In consequence, at a certain degree of shortening, the fibre seen by common light may appear homogeneous without appreciable transverse striæ—the stage of homogeneity or of transition. If the shortening is carried further the transverse striæ corresponding to the isotropic disks are seen to reappear. At any given phase of the process of contraction, consequently even in the transition stage, the isotropic and anisotropic substances may be recognised by means of the polarising microscope as well-defined and regularly alternating strata. They do not, at the time of contraction, exchange their respective places in the muscular compartment. The thickness of both strata decreases during contraction, that of the isotropic layer much more rapidly than that of the anisotropic. The total volume of each compartment does not vary sensibly during contraction. The anisotropic strata increase in volume at the expense of the isotropic, as during contraction liquid passes from the latter to the former.

Some interesting researches on electric fishes have been communicated to the French Academy of Sciences by E. J. Marey. Physiologists have been struck with the analogies presented by a muscle and the apparatus of electric fishes. These two kinds of organs, both subject to the will and provided with nerves for centrifugal action, have further a very analogous chemical composition, and even some points of structural resemblance. These

views, put forward before physicists had developed the theory of the correlation of forces, were necessarily very vague. It might even be conceived that in the living organism, as well as in our physical instruments, analogous conditions might produce either mechanical work or electricity. Having found that muscular acts are complex, *i.e.*, that a muscle in tetanus or in contraction executes a series of minute successive movements, which M. Marey calls *shocks*, which accumulate to produce muscular attraction, he has examined the discharge of the torpedo, and found there a similar complexity. Having passed this discharge through an electro-magnetic tracing apparatus, he found that it was made up of minute shocks, which recur at the rate of 150 in a second. Cold reduces the rate alike of the muscular and electric shocks, whilst heat acts inversely. Hence M. Marey concludes that these two functions are really homologues. The gymnotus gave similar results to those of the torpedo. The latter fish, when connected with a telephone and slightly excited, produced a very short croaking. If a prolonged discharge is occasioned by pricking the electric lobe of the brain, the sound produced lasts three or four seconds, and in tonality borders upon *mi* (165 vibrations).

On examining with the spectroscope, both by absorption and by means of the electric spark, the products of his operations on the mixture of earths from samarskite, M. Lecoq de Boisbaudran has observed rays or bands not to be referred to any element formerly known, and not corresponding to the descriptions of the spectra of the earths recently announced by MM. Delafontaine, L. Smith, Soret, and De Marignac. These new rays of absorption and emission seem to belong to one and the same body. The emission spectrum is composed of four bands shaded towards the left and formed of narrow rays, the strongest of which is the most refrangible and forms the right margin of the band. The absorption spectrum comprises two strong bands in the blue, and several rays of less importance in the green. The metal which yields these new spectra is precipitated as a double potassic sulphate along with didymium ; its simple sulphate is rather less soluble than that of didymium ; its oxalate is precipitated along with didymium, but ammonia separates the oxide of the new metal before that of didymium.

An improvement in Bunsen's battery is described in " Les Mondes " by M. Lefebure. The oxidation of the exterior surface of the zincs contributes nothing to the liberation of electricity, so it may be safely covered with varnish, thus reducing the consumption of zinc by one-half.